

ΣΧΟΛΗ ΙΚΑΡΩΝ

ΤΜΗΜΑ ΑΕΡΟΠΟΡΙΚΩΝ ΕΠΙΣΤΗΜΩΝ



# Ίκάρου Επιστήμη

Τεύχος Α'

Μάιος 2008

# ΣΧΟΛΗ ΙΚΑΡΩΝ



## ΤΜΗΜΑ ΑΕΡΟΠΟΡΙΚΩΝ ΕΠΙΣΤΗΜΩΝ

# Ικάρου Επιστήμη

Περιοδικό της ακαδημαϊκής κοινότητας της Σχολής Ικάρων

### **Τεύχος 1ο**

**Περιλήψεις Δημοσιεύσεων – Ανακοινώσεων Μόνιμου  
Διδακτικού Εκπαιδευτικού Προσωπικού  
σε Επιστημονικά Συνέδρια και Περιοδικά**

***Περίοδος 2003 – 2007***

**Αθήνα 2008**



## ΠΡΟΛΟΓΟΣ

Με ιδιαίτερη χαρά, τιμή και αίσθημα ευθύνης παραδίδουμε στη δημοσιότητα το Α' τεύχος του περιοδικού «ΙΚΑΡΟΥ ΕΠΙΣΤΗΜΗ» με τη φιλοδοξία να αποτελέσει περιοδική –ανά έτος– σπουδή στις αεροπορικές επιστήμες.

Το περιοδικό «Ίκάρου Επιστήμη», είναι μια διεπιστημονική συλλογή περιλήψεων επιστημονικών εργασιών του Διδακτικού Εκπαιδευτικού Προσωπικού της Σχολής. Οι εργασίες αυτές έχουν δημοσιευθεί σε έγκριτα διεθνή περιοδικά και πρακτικά συνεδρίων με κριτές, και έχουν προκύψει κυρίως από την ερευνητική δραστηριότητα του Διδακτικού Εκπαιδευτικού Προσωπικού αλλά και από τις Διπλωματικές Εργασίες των Ικάρων της περιόδου 2004-2007. Οι ανωτέρω επιστημονικές εργασίες –ορισμένες εκ των οποίων έχουν λάβει διεθνείς διακρίσεις– έχουν ιδιαίτερως μεγάλη αξία, αν ληφθούν υπόψη οι αντίξοες συνθήκες υπό τις οποίες αυτές πραγματοποιήθηκαν, λόγω του σεισμού του 1999 που κατέστρεψε τη Σχολή.

Η έκδοση του περιοδικού συμπίπτει χρονικά με τα εγκαίνια των νέων κτηριακών εγκαταστάσεων της Σχολής Ικάρων και με τον συντελούμενο Ακαδημαϊκό εκσυγχρονισμό κατ' εφαρμογή των Νόμων 3187/2003 και 3413/2005 που επιβάλουν τόσο της μετάδοσης της γνώσης με τη διδασκαλία όσο και την παραγωγή της μέσα από τη βασική και εφαρμοσμένη έρευνα. Συμπίπτει παράλληλα και με την καθιέρωση νέων θεσμών και αντιλήψεων για την δημιουργία ενιαίας τρίτοβάθμιας εκπαίδευσης σε ευρωπαϊκό επίπεδο μέσα από τη διακήρυξη της Μπολόνια και της κινητικότητας από διεθνείς δράσεις όπως του Military Erasmus και της Ένωσης Αεροπορικών Ακαδημιών (EUAFSA).

Το Διδακτικό Εκπαιδευτικό Προσωπικό της Σχολής θα συνεχίσει την εργώδη προσπάθειά του ανταποκρινόμενο στην εμπιστοσύνη της ηγεσίας της Π.Α. και της Διοικήσεως της Σχολής με αποκλειστικό σκοπό την αναβάθμιση της εκπαίδευσης των Ικάρων και την εδραίωση ενός Ακαδημαϊκού περιβάλλοντος ανταποκρινόμενου στις τρέχουσες και μελλοντικές απαιτήσεις της Π.Α.

Δεκέλεια, Μάϊος 2008

**Καθηγητής Πέτρος Ν. Κωτσιόπουλος**

Κοσμήτορας Σ.Ι.

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ΣΧΟΛΗ ΙΚΑΡΩΝ  
ΤΜΗΜΑ ΑΕΡΟΠΟΡΙΚΩΝ ΕΠΙΣΤΗΜΩΝ

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## 9. Τομέας Θερμοδυναμικής, Πρωθητικών & Ενεργειακών Συστημάτων

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ΣΧΟΛΗ ΙΚΑΡΩΝ  
ΤΜΗΜΑ ΑΕΡΟΠΟΡΙΚΩΝ ΕΠΙΣΤΗΜΩΝ

## *Περίληψεις Δημοσιεύσεων*

## 1. Τομέας Ηγετικής – Διοικητικής, Ανθρωπιστικών Επιστημών και Φυσιολογίας

1. Euphrosyne Efthimiadou, Comment élaborer un curriculum pour l'apprentissage du français langue seconde?, 5<sup>o</sup> Congrès Panhellénique des Professeurs de F.L.E. Athènes, 2-5 Décembre 2004, Université d' Athènes (Faculté des Lettres, Ilissia).

### Περίληψη

Le débat actuel sur la nécessité d'innover les politiques éducatives et de restructurer les contenus d'enseignement demeure ouvert. Dans ce cas, l'élaboration d'un programme d'études pour l'apprentissage du français langue seconde s'associe aux pratiques de l'enseignant et aux apprentissages acquis par les sujets. Par conséquent, le défi de la pertinence des objectifs d'apprentissage et des contenus d'enseignement se pose. Plus précisément, dans le domaine de l'apprentissage de langues étrangères on devra s'adapter à la politique linguistique définie par le Cadre européen commun de référence du Conseil de l'Europe en vue d'ouvrir les perspectives pour une orientation multidimensionnelle et modulaire. Après s'être intéressé à cultiver des compétences transversales communes à différentes disciplines, on est invité à savoir organiser efficacement l'interconnexion entre citoyenneté, éducation et formation. En fin de compte, la Francophonie vise à assurer la diversification linguistique et culturelle en articulant à la fois l'unité et la diversité.

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2. Δρ. Ευφροσύνη Ευθυμιάδου, Καλλιεργώντας τεχνικές ενεργοποίησης/εμπύκωσης ομάδας στην διαδικασία εκμάθησης της Γαλλικής ως Δεύτερης ξένης γλώσσας, University of Athens – Language Center, the International Conference “Language in a Changing World”, December 9-11, 2005.

### Περίληψη

Στα πλαίσια του Διεθνούς Συνεδρίου με θέμα «Η γλώσσα σε έναν κόσμο που αλλάζει» που οργανώθηκε από το Διδασκαλείο Ξένων Γλωσσών του Εθνικού και Καποδιστριακού Πανεπιστημίου Αθηνών, ήταν έκδηλη η ανάγκη να εκφραστούν οι διαφορετικές προσεγγίσεις που πραγματοποιούνται σε ένα παγκόσμιο περιβάλλον, ώστε να ευαισθητοποιηθούμε όλοι εμείς που διαπραγματευόμαστε την παιδαγωγική προσέγγιση μίας ή περισσότερων ξένων γλωσσών πέρα από την μητρική μας.



Η αναζήτηση νέων τρόπων προσέγγισης της παιδαγωγικής διαδικασίας οδηγεί στην υιοθέτηση τεχνικών ενεργοποίησης / εμπύχωσης της ομάδας που θα δημιουργούν τις κατάλληλες προϋποθέσεις για την καλλιέργεια επικοινωνιακών δεξιοτήτων αλλά που βοηθούν κυρίως στην διεύρυνση της κριτικής και δημιουργικής σκέψης.

Έτσι, η ενεργοποίηση της ομάδας μέσα στην διδακτική διαδικασία της γαλλικής ως δεύτερης ξένης γλώσσας είναι μία παράμετρος που παρουσιάζει ιδιαίτερο ενδιαφέρον, καθώς η ενεργής συμμετοχή και ενσωμάτωση του κάθε μέλους της ομάδας θεωρείται θεμελιώδης για την πρόοδο και την μελλοντική εξέλιξη του όσπου να ενταχθεί στους κόλπους του κοινωνικού και επαγγελματικού χώρου.

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3. **Dr. Euphrosyne Efthimiadou, Quelles tâches communicatives peut-on réaliser en classe de langue en vue de cultiver les compétences du groupe?, 6<sup>e</sup> Congrès Panhellénique des Professeurs de Français, L' enseignement du français aujourd'hui: nouvelles perspectives, Hôtel CAPSIS S.A., 22-24 septembre 2007.**

#### **Περίληψη**

Si l' on s'intéresse à définir le processus de l'apprentissage d'une langue, il est important de définir la nature et l'exécution de la tâche à entreprendre. Plus précisément, la réalisation d'une tâche communicative nécessite l'acquisition stratégique de compétences requises. Car la communication fait partie intégrante des tâches dans lesquelles les participants s'engagent afin de cultiver des compétences à l'oral, à l'écrit ou même en interaction.

Sous cet aspect, il s'avère important d'étudier, d'une part, le processus des tâches communicatives, d'autre part, de mentionner des techniques de motivation du groupe et enfin de signaler l'importance de l'instauration des situations constructives.

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4. **Dr. Euphrosyne Efthimiadou, Formation Continue: Enseignement du f.o.s. et formation des adultes, la revue FLECHE, le bulletin des professeurs en FLE, Chypre, 2004.**

#### **Περίληψη**

Au seuil du XXI<sup>e</sup> siècle et à la suite des exigences d' une Europe unie, le chemin qui conduit à l' apprentissage des langues vivantes connaît un élargissement mais aussi une finalité. En ce qui concerne l' apprentissage du FLE, on observe qu' il s' adresse à des publics hétérogènes. Il y a quelques

années, l'enseignement du français précoce, destiné aux enfants, s'est développé. D'autre part, l'enseignement du français à but professionnel vise à un public spécialisé. C'est pourquoi, on signale qu'on assiste à l'apprentissage du français au lieu de préciser qu'on apprend le français.

On peut d'abord aborder l'approche didactique du français professionnel centré sur des objectifs spécifiques (F.O.S.) et destiné à des publics spécifiques. Par la suite, on va s'interroger sur la formation des enseignants tout en proposant une série de techniques d'intervention.

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5. **Lascaratou, C., & Hatzidaki, O., (2003) Pain as Process in Modern Greek: the Case of Pono, Journal of Greek Linguistics 3.**

#### **Περίληψη**

This paper presents the results of a pilot study of the verbal expression of pain in Modern Greek and forms part of an on-going, large-scale, corpus-based investigation. On the basis of a first taxonomy of lexico-phraseological forms and syntactic structures derived from authentic doctor-patient dialogues, it will be shown that, in Greek, pain is primarily viewed as process, secondarily as participant and only marginally as quality. In the light of Halliday's (1985/1994) functional analysis, we shall focus on the wording of pain through the verb pono 'hurt', viewed from the standpoint of transitivity. On the strength of our spoken data, it will be argued that in Greek there is a clear tendency for pain to be predominantly configured as an intransitive personal process, with the body part only rarely being construed as the locus of pain. This tendency reveals that pain is understood as residing in the sufferer's self as a whole rather than in just some part of the body.

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6. **Hatzidaki, O. (2004) Using Corpora and the Internet as Textual Resources for the Promotion of Modern Greek as a Foreign Language, στο: Dendrinos, M., & Mitsikopoulou, M., (eds.) Policies of Linguistic Pluralism and the Teaching of Languages in Europe, Metaixmio, Athens.**

#### **Περίληψη**

This paper presents methods of exploiting the vast amounts of language data in electronic form which are available on the Internet, for the purposes of teaching Modern Greek as a foreign language (hereafter TMGFL). Specifically, it describes practical ways of using such data as a basis for the creation of teaching materials which will involve the learner in a process of exploration and discovery of the

formal and functional features of the Modern Greek language, instead of their passive accumulation by him or her. This method is expected to contribute to a firmer consolidation of the linguistic information, as well as a wider exposure to the cultural elements encapsulated in language. Although the methods described below are language-independent, Modern Greek (henceforth MG) has been selected as our main focus, firstly, as a characteristic example of a lesser-spoken language in need of promotion, and, secondly, as a foreign language in slowly but steadily increasing demand.

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7. **Symeon, D., Teaching Writing: Cross-linguistic and Cross-cultural Perspectives, 3<sup>rd</sup> Conference of the European Association for the Teaching of Academic Writing, Hellenic American Union, Athens, Greece, 22-24 June, 2005.**

### **Περίληψη**

Research in various areas of linguistics, sociolinguistics, discourse analysis and teaching methodology (Blum-Kulka 1982, 1983; Coffin 2004; Cohen and Olshtain 1993; Coulmas 1981; Dendrinos 1984, 1986; Holmes 1992, 1995; Papaefthymiou-Lytra 1990; Shuck and Paxton 2002; Symeon 1994, 2000; Thomas 1983) has emphasized the social role of language, which can be viewed as a way of social behaviour. This role has greatly affected foreign language teachers, who do not only transmit knowledge of the language to be learnt, but also help their students use this language appropriately in specific situations overcoming problems arising from the socio-cultural differences between the native language and the foreign language. Such problems can be traced in all areas of language learning, i.e. reading, writing, listening and speaking.

In this paper, an attempt is made to identify problems of socio-cultural significance faced by English instructors who teach Academic Writing. Our aim is to sensitise our students with the possible differences in writing cultures, styles and linguistic conventions between English and Greek. This sensitization will enable them to perceive more clearly the distinction between universals and specifics in writing and, therefore, avoid linguistic mistakes of social significance.

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8. **Hatzidaki, O. (2006) Evaluation of the Spoken Lexicophraseological Skills of Greek University Students of English: a Corpus-based Approach, Proceedings of the International Conference “Foreign Language Teaching in Tertiary Education”, 9-10 June 2005, Epirus Institute of Technology, Dionikos Publications, Athens.**

## Περίληψη

This paper presents the initial findings of a large-scale corpus-based study of the spoken phraseology of Greek university students of English. The research is based on the *Contrastive Interlanguage Analysis* model (Granger 2002), whereby comparisons of linguistic features are carried out on comparable corpora of English language learners and native speakers (the present study uses the LOCNEC corpus and the Greek component of the LINDSEI corpus respectively; De Cock 2004). Our analysis shows that, firstly, the phraseology of speech is inextricably linked to its interactive nature and to the linguistic phenomena by which interactiveness is effected (e.g. discourse markers); and, secondly, although Greek learners are to a certain extent aware of the phraseological system of native speech, their collocational practices diverge considerably from those of native speakers, both quantitatively (i.e. concerning the type and range of the phraseological features employed) and qualitatively (i.e. concerning the pragmatic functions fulfilled by those features). As a potential remedy, an example of a corpus-driven awareness-raising exercise is proposed.

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9. **Hatzidaki, O., *A Corpus-Based Approach to Modern Greek Language Research and Teaching*, στο Teubert, W., & Krishnamurthy, R. (eds) *Corpus Linguistics: Critical Concepts in Linguistics*, Routledge, London.**

## Περίληψη

Modern Greek (MG) does not have a strong tradition of empirical linguistic research such as many other European languages have. A major lack has been in the use of corpora. In the pre-electronic age, traditional grammars used a variety of sources without any systematic criteria, and relied heavily on introspection. Modern grammars are based on a more systematic collection of data but, in general, where corpora are used in linguistic research, they are not fully exploited and generalizations on sociolinguistic issues (cf., Kavoukopoulos 1989, Holton 1990), for example, are claimed on the basis of relatively small amounts of data. Philippaki-Warbuton aptly summarizes

the problem when she points out the need for “up to date descriptions under the guidance of the linguist” (1990:64) and the need for “objective linguistic and sociolinguistic appraisal of MG” (1990:65). It is our view that corpora are an excellent way of meeting this need.

In the last two decades, the small amount of work that has been done on Modern Greek corpora has remained little known outside the group of specialists for whom it was intended. In order to improve the availability of information on current and recent work, we designed and distributed a questionnaire to obtain information on the specifications (nature and size of corpus, hardware and software, processing tools and intended users and applications) of any corpus

projects there might be. The response over a period of 6 months was quite encouraging and the findings are summarized in Appendix 1 here, although we cannot guarantee their comprehensiveness. They are discussed in detail in Goutsos, Hatzidaki and King (1993).

The survey findings indicate a respectable beginning to computer-based projects. There are two major projects aiming at the design of a general corpus of MG (CTI and ILSP, currently 10 million words each, with plans for expansion). Apart from general corpora, there are also literary corpora, specialized corpora and spoken corpora.



## 2. Τομέας Μαθηματικών – Φυσικών Επιστημών

1. Patsourakos, A., On some Properties of Hall Elements in the Free Nonassociative Algebra, Acta Math. Hungar., 118 (3), 2008, first published online December 3, 2007.

### Περίληψη

We study certain aspects of a particular Hall set constructed with respect to the alphabetical order. In our main result we show how this Hall set leads to the construction of a family of generators of the kernel of “from right to left Lie bracketing” mapping. This construction is based on certain remarkable properties of these generators.

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2. Patsourakos, A., On Nilpotent Properties of Leibniz Algebras, Communication in Algebra 35, 2007.

### Περίληψη

Leibniz algebras are introduced by Loday (1993) as nonantisymmetric generalization of Lie algebras. Some structure results concerning nilpotency of Leibniz algebras are due to Ayupov and Omirov (1998). The main result in this article (Theorem 7) can be considered as a generalization of a well-known result that if a finite-dimensional Lie algebra acts on a vector space by nilpotent endomorphisms, then these have at least one common eigenvector corresponding to their unique eigenvalue zero.

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3. Πατσουράκος, Α., On Nilpotent and Solvable Leibniz Algebras, 7<sup>ο</sup> Πανελλήνιο Συνέδριο Άλγεβρας και Θεωρίας Αριθμών, Καρλόβασι Σάμου, Μάιος 2007.

### Περίληψη

Lie algebras are special cases of Leibniz algebras. The theory of Lie algebras will serve us as a model of suitable generalizations to Leibniz algebras. Loday (1993) has investigated Leibniz algebras in connection with properties of cyclic and Hochschild homology of matrix algebras. In fact, most papers concerning Leibniz algebras are devoted to the study of homological problems. The structure theory of Leibniz algebras mostly remains untouched. The presentation is devoted to nilpotent and solvable Leibniz algebras.

### 3. Τομέας Αεροδυναμικής – Μηχανικής Πτήσης

1. **Georgantopoulos, A.G., Morisson, H.J., Panaras, G.A., Gatski, B.T., Analysis of Extensive Cross-Flow Separation Using Higher-Order RANS Closure Models, 21<sup>st</sup> AIAA Applied Aerodynamics Conference, June 23-26, 2003, Orlando, FL.**

#### Περίληψη

The turbulent flow fields associated with the incompressible flow over a 6: 1 prolate spheroid at high angle of attack, and the supersonic flow over an ogive cylinder are

studied. Both these flows are characterized by large separation and vortical flow regions and therefore provide a challenging database for comparison of turbulent closure models. Of interest is the ability to predict the effects of separation and associated vortical motion common to both flows. Two turbulent models are investigated that each represent the class of linear eddy-viscosity models (LEVMs) and explicit algebraic stress models (EASMs). Since the EASM accounts for anisotropic effects, the influence of these effects on flow field predictions can be assessed. The EASM model is shown to both improve the separation location prediction and pressure trough under the secondary vortex on the 6:1 prolate spheroid at high angle of attack and high Reynolds number, and improve the prediction of the separation location on a

supersonic ogive cylinder.

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2. **Γεωργαντοπούλου, Γ.Χρ., Γεωργαντόπουλος, Α.Γ., Πάππου, Ι.Θ., Τσαγγάρης, Γ.Σ., Εφαρμογή Καρτεσιανών Πλεγμάτων στην Επίλυση Πεδίων Ροής γύρω από Καμπυλόγραμμες Γεωμετρίες, Recent Advances in Mechanics and the Related Fields, University of Patras, 2003.**

#### Περίληψη

Στην παρούσα εργασία παρουσιάζεται μία μεθοδολογία επίλυσης των εξισώσεων Navier-Stokes ασυμπίεστου ρευστού, για την προσομοίωση πεδίων ροής σε γεωμετρίες με καμπυλόγραμμο περίγραμμα, με αποκλειστική χρήση καρτεσιανών πλεγμάτων. Για την επίλυση των εξισώσεων χρησιμοποιείται μία μεθοδολογία ψευδοσυμπίεστότητας σε συνδυασμό με τη μέθοδο διαχωρισμού των συναγωγικών μητρώων ροής για ασυμπίεστο ρευστό. Η προσέγγιση της καμπυλόγραμμης γεωμετρίας γίνεται με την κλιμακωτή μέθοδο (saw-tooth) ή με τη διαγώνια μέθοδο (diagonal) με σκοπό να πετύχουμε τη μεγαλύτερη δυνατή ακρίβεια. Η μέθοδος αυτή εφαρμόζεται για ασυμπίεστη και μόνιμη ροή για

διάφορες γεωμετρίες, όπως ροή σε σειρά πτερυγίων και ροή γύρω από συμμετρική αεροτομή. Γίνεται σύγκριση μεταξύ του καρτεσιανού και καμπυλόγραμμου πλέγματος με ικανοποιητικά αποτελέσματα. Παρουσιάζονται επίσης τα πλεονεκτήματα και τα μειονεκτήματα της μεθοδολογίας καθώς και τα όρια ευστάθειας των αποτελεσμάτων.

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3. **Georgantopoulou, G.Chr., Georgantopoulos, A.G., Pappou, I.Th., and Tsangaris, S., Block NESTED Refinement Technique for the Navier Stokes Equations, 4<sup>th</sup> International Conference on Heat Transfer, Fluid Mechanics and Thermodynamics, Cairo, Egypt, HEFAT 2005.**

#### **Περίληψη**

A Cartesian grid block refinement technique, for the prediction of flows inside domains of arbitrary shaped bounds is presented. The method is applied for the solution of incompressible Navier-Stokes equations. We create an approximate Cartesian geometry bound by the use of saw tooth method and we succeed to avoid the complexity of the body fitted numerical grid generation procedure, as curvilinear geometries are approached solely by the use of Cartesian grid lines. The refinement method is based on the use of a sequence of nested rectangular meshes in which numerical simulation is taking place. The method is applied for laminar flows and based on a cell-centre approximation projection. We present the numerical simulation of both an internal and an external flow, about the fluid flow inside a driven cavity and around a symmetric airfoil respectively. The utility of the algorithm is tested by comparing the convergence characteristics and accuracy to those of the standard single grid algorithm. The Cartesian block refinement algorithm can be used in any complex curvilinear geometry simulation, to accomplish a reduction in memory requirements and the computational time effort.

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4. **Georgantopoulou, G.Chr., Georgantopoulos, A.G., and Tsangaris, S., Incompressible Navier Stokes Equations Solution Using Block Nested Cartesian Grid, 25<sup>th</sup> International Congress of the Aeronautical Sciences, ICAS 2006.**

#### **Περίληψη**

A method for the solution of the incompressible Navier-Stokes equation for the prediction of flows inside domains of arbitrary shaped bounds by the use of Cartesian grids with block-refinement in space is presented. In order to avoid the complexity of the body fitted numerical grid generation procedure, we use a saw tooth method for the curvilinear geometry approximation. The refinement method is



based on the use of a sequence of nested rectangular meshes in which numerical simulation is taking place. The method is applied for laminar flows and based on a cell-centre approximation projection. We present the numerical simulation of both an internal and an external flow, about the fluid flow inside a stenosed tube and around a symmetric airfoil respectively. The utility of the algorithm is tested by comparing the convergence characteristics and accuracy to those of the standard single grid algorithm. The Cartesian block refinement algorithm can be used in any complex curvilinear geometry simulation, to accomplish a reduction in memory requirements and the computational time effort.

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5. **Georgantopoulou, G.Chr., Georgantopoulos, A.G., and Tsangaris, S., Numerical Simulation Around Curvilinear Geometries Using Block Nested Cartesian Grids.**

#### **Περίληψη**

A method for the numerical simulation and computation for the prediction of flows inside and around domains of curvilinear shaped bounds by the use of Cartesian grids is presented. In order to avoid the complexity of the body fitted numerical grid generation procedure, we use a saw tooth method for the curvilinear geometry approximation. In order to reduce the large memory requirements we apply a refinement method, which is based on the use of a sequence of block nested rectangular meshes. In each one of these block meshes, numerical computation is taking place. The method is applied for incompressible laminar flows and based on a cell-centre approximation projection. We present the numerical simulation of both an internal and an external flow, about the fluid flow inside a stenosed tube and around a symmetric airfoil respectively. The utility of the algorithm is tested by comparing the convergence characteristics and accuracy to those of the standard single grid algorithm. The Cartesian block refinement algorithm can be used in any complex curvilinear geometry simulation, to accomplish a reduction in memory requirements and the computational time effort.

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6. **Lekas, I.Th., Mavromatidis, E., and Kallos, G., Some Considerations on the Airborne cloud Microphysical Probing, Meteorol Atmos Phys, Published online: Dec. 22, 2005.**

#### **Περίληψη**

This paper provides a theoretical calibration of Optical Array Probes (OAP) mounted on a given aircraft, in order to take into account the aerodynamic influence of the entire aircraft on the measurements obtained. The measured

parameters are corrected through the computation of the air flow-field around the entire aircraft carrying the probes, for different flight conditions, in order to obtain the corresponding undisturbed values. These undisturbed values have been compared to the microphysical ones

computed by an atmospheric model, the Regional Atmospheric Modeling System (RAMS). It was found that the removal of the disturbances made by the aircraft on the

atmospheric conditions is feasible and provides data that compare much better to the model results. It is suggested that such kind of airborne data corrections may be performed in order to improve the quality of the observations if the aircraft and probe geometries are known. Further information regarding the best location of the OAP probes on the considered aircraft is also obtained.

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7. **Mavromatidis, E., Lekas, I.Th., Kallos, G., Analysis of a Two-Layer Cloud System with RAMS Model and Comparison to Airborne Observations, Environ Fluid Mech, Received: July 18, 2007, Accepted: September 26, 2007.**

### **Περίληψη**

A three-dimensional numerical model (Regional Atmospheric Modeling System-RAMS) was used to study the formation and evolution of water forms in a two-layer cloud structure observed during a field campaign over Brest (France). The model performance in regular operations, using conventional meteorological data as initial and lateral boundary conditions, was also examined. Remote sensing observations of the cloud system and in-situ aircraft data, selected during the campaign, were used to validate the model outputs. The model simulations showed that the lower cloud formation was characterized by high number concentration of pristine ice and snow, while the concentration of aggregates, graupel and hail were considerably lower. Hydrometeors in liquid phase appeared demonstrating high number concentration and water content on the top of this layer. The upper cloud layer consisted only of frozen water substances in lower amounts. The qualitative and quantitative comparison of the model-calculated meteorological and microphysical fields to the available observational data revealed that the model reflected fairly well the cloud structure (e.g., the spatio-temporal variability of the cloud parameters, the geometry of the cloud system). However, there were deviations as far as the model underestimating the ice water content (IWC) and number concentration (Nt) fields is concerned, especially at the atmospheric layer between 2.5 and 4 km of altitude. These deviations of the model simulated quantities from the measured ones may be attributed either to the performance of the model's microphysics scheme, to instrument inaccuracies and to the local disturbance caused by the aircraft.

8. Τόλης Ηλίας, Τζίνιας Ηρακλής και Συνεργάτες: Λέκας Θεόδωρος, Ασούτη Βαρβάρα, Ζερβογιάννης Θωμάς, Λιακόπουλος Παναγιώτης, Προκαταρκτική Διαστασιολόγηση, Παραμετροποίηση και Ανάλυση-Σχεδιασμός με Λογισμικό Υπολογιστικής Ρευστοδυναμικής Ελαφρού μη Επανδρωμένου Αεροσκάφους, Τεχνικά Χρονικά, Μάρτιος-Απρίλιος 2007.

### Περίληψη

Η παρούσα εργασία συνοψίζει το αποτέλεσμα των διπλωματικών εργασιών [1,2] των δύο πρώτων συγγραφέων, οι οποίες πραγματοποιήθηκαν στον Τομέα Ρευστών της Σχολής Μηχανικών ΕΜΠ. Η εργασία ξεκινά με την προκαταρκτική διαστασιολόγηση ενός ελαφρού μη-επανδρωμένου αεροσκάφους (Unmanned Aerial Vehicle - UAV ), ενδεικτική αποστολή του οποίου μπορεί να είναι η δασική επιτήρηση και η έγκυρη ενημέρωση σε περίπτωση πυρκαγιάς ή άλλων φυσικών καταστροφών. Το προϊόν των δύο διπλωματικών εργασιών έλαβε τη μορφή εύχρηστου λογισμικού, ικανού να καλύψει αντίστοιχες μελλοντικές ανάγκες ή να επικουρήσει ενδεχόμενη παραμετρική διερεύνηση ή βελτιστοποίηση του προηγθέντος σχεδιασμού. Χρησιμοποιώντας τα αποτελέσματα της προκαταρκτικής διαστασιολόγησης, δημιουργήθηκε μια πλήρης και αυτοματοποιημένη διαδικασία ώστε να παραχθεί η περιβάλλουσα επιφάνεια του σχεδιασθέντος αεροσκάφους, επιθέτοντας σε αυτήν επιφανειακό πλέγμα τριγωνικών στοιχείων. Η δημιουργία του πλέγματος είναι παραμετρική και, συνεπώς, η ίδια διαδικασία-λογισμικό μπορεί να παράγει πλέγμα σε οποιοδήποτε αεροσκάφος προκύπτει από την ίδια παραμετροποίηση. Το επιφανειακό πλέγμα χρησιμοποιήθηκε για τη δημιουργία 3D μη-δομημένου πλέγματος τετραεδρικών στοιχείων, για την πρόλεξη του πεδίου ροής γύρω από το αεροσκάφος, μέσω της αριθμητικής επίλυσης των εξισώσεων Navier-Stokes σε πολυεπεξεργαστικό υπολογιστικό σύστημα. Τα προηγούμενα συνθέτουν ένα πλήρες σύνολο κωδίκων το οποίο, αν λ.χ. ενταχθεί στο πλαίσιο ενός εξελικτικού αλγορίθμου, είναι ικανό να οδηγήσει στην αεροδυναμική βελτιστοποίηση μορφής του μη-επανδρωμένου αεροσκάφους. Μια τέτοια βελτιστοποίηση δεν πραγματοποιήθηκε στο πλαίσιο αυτών των διπλωματικών εργασιών, με σκοπό να αποτελέσει αντικείμενο επόμενων εργασιών.

Ο ηλεκτρονικός εξοπλισμός που απαιτείται για τη δασική επιτήρηση προέκυψε από βιβλιογραφική επισκόπηση και έρευνα αγοράς. Κατά το σχεδιασμό, αυτός ελήφθη υπόψη ως ανελαστικά δεδομένα επιπλέον βάρους και όγκου. Εν τούτοις, η εργασία αυτή εστιάζει στην αεροδυναμική ανάλυση και σκόπιμα παραλείπει θέματα σχετικά με τον ηλεκτρονικό εξοπλισμό (αλλά και τον ίδιο τον κινητήρα), τα οποία άπτονται εμπορικών μοντέλων.



## 4. Τομέας Μηχανολογικών Κατασκευών, Τεχνολογίας των Υλικών, Οργάνωσης Παραγωγής

1. Mamalis, G.A., Grabchenko, I.A., Magazeev, G.M., Krukova, V.N., Prohászka, J., and Vaxevanidis, M.N. (2004) Two-stage Electro-Discharge Machining fabricating superhard cutting tools, J. Mater. Process. Techn., 146 (3), pp. 318-325.

### Περίληψη

A novel technique for fabricating efficiently precision cutting tools made from polycrystalline superhard materials is reported in the present paper. For this purpose, a two-stage electro-discharge machining (EDM) was applied on diamond polycrystallines, by employing first wire-electrode EDM for rough cutting and subsequently rotational disc-electrode EDM for finishing operations. Experimental results obtained clearly indicate the applicability of the proposed two-stage technique for fabricating precision cutting tools that can be used for the production of machined components made from glass and plastics, ceramics, composite materials and non-ferrous metals, at an industrial scale.

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2. Petropoulos, P.G., Vaxevanidis, M.N., and Pantazaras, N.C. (2004) Modeling of surface finish in electro-discharge machining based upon statistical multi-parameter analysis, J. Mater. Process. Techn., 155-156, pp. 1247-1251.

### Περίληψη

A multi-parameter analysis of surface finish imparted to Ck60 steel plates by electro-discharge machining (EDM) is presented. The interrelationship between surface texture parameters and process parameters is emphasized. An increased number of parameters is studied including amplitude, spacing, hybrid, as well as random process and fractal parameters. The correlation of these parameters with the machining conditions is investigated. Observed characteristics become more pronounced, when intensifying machining conditions. Close correlation exists between certain surface finish parameters and EDM input variables and single and multiple statistical regression models are developed.

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3. **Petropoulos, P.G., Vaxevanidis, M.N., Pantazaras, N.C., and Antoniadis, T.A., (2004) Control of representative turned surface textures, Wear, 257 (12), pp. 1270-1274**

#### **Περίληψη**

A method for characterizing machined surface textures corresponding to varying cutting conditions, which lead to differing profile shapes, is presented here. Through a proper multi-parameter analysis carried out on turned steel specimens, it is indicated that statistical functions and parameters are the most effective towards relative discrimination and control. Moreover it is concluded that fractal geometry cannot give information on the texture shape at the scale of the tool traces but as the state of micro-fracture changes on the different surfaces, the fractal dimension presents distinctive power. On the other hand, the most sensitive measures for the distinction systems between the different surfaces are revealed to be Beta and Pearson statistical systems parameters.

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4. **Petropoulos, P.G., Vaxevanidis, M.N., Pantazaras, N.C., and Antoniadis, T.A. (2006), Multi-parameter identification and control of turned surface textures corresponding to various cutting factors - new typology charts, Int. J. Adv. Manufacturing Technol, 29, pp. 118-128.**

#### **Περίληψη**

A method for characterizing turned surface textures corresponding to varying cutting variables leading to differing profile shape is presented with emphasis on a global view of turning machinability parameters. Through a multi parameter experimental analysis of turned steel specimens, several standardized parameters are developed. The ability of these parameters are tested to distinguish between different profiles in shape or to identify some particular features with respect to cutting factors. It is indicated that texture statistical functions and parameters are the most effective for relative discrimination and control. Based on the results of this study, new maps for turned surface control are developed. With regards to the variability of some of the parameters at different surface measuring sites, it is evident that the amount of scatter is lower when cutting factors offer regular chip formation.

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5. **Petropoulos, P.G., Vaxevanidis, M.N., Iakovou A., and David, K., (2006) Multi-Parameter Modeling of Surface Texture in EDMachining using the Design of Experiments Methodology, Mat. Sci. Forum, 526, pp. 157-162.**

## Περίληψη

This study concerns the formulation of a multi-parameter surface texture model in EDMachining of AISI D2 tool steel. The model is developed in terms of pulse current and pulse-on time which are the dominant machining conditions, via factorial design of experiments. By applying analysis of variance and statistical multi-regression analysis to the experimental data close correlation is proved between certain surface finish parameters and the machining conditions, with pulse current exerting the strongest influence. By applying this model the appropriate conditions for successful finish can be selected, as well as functional surface characteristics can be quantified.

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6. Vaxevanidis, M.N., Koutsomichalis, A., Manolakos, E.D., and Petropoulos, P.G., (2006) Surface integrity and tribology behavior of plasma sprayed alumina coatings on steel and aluminum substrates, J. Balkan Tribological Assoc., 12(1), pp.95-103.

## Περίληψη

Ceramic coatings produced by thermal spray techniques are widely used to improve wear and corrosion resistance of working metal surfaces. In the present paper we report on the surface integrity states and the tribological behaviour of plasma-sprayed alumina coatings on steel and aluminum substrates. The influence of arc current employed during the spraying processes on the two previous mentioned aspects is also examined.

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7. Petropoulos, P.G., Vaxevanidis, M.N., and Pantazaras, N.C., Statistical multi-parameter analysis of E.D.Machined Surface Textures, Proc. Int. Conf. on Advanced Materials & Processing Technologies, Dublin, Ireland, 8-11/7/2003, II, pp. 885-888.

## Περίληψη

A multi parameter analysis of surface finish imparted to Ck 60 steel plates by electro-discharge machining is presented. The interrelationship between surface texture parameters and process parameters is emphasized. Based on ISO 4287(1997) an increased number of parameters were studied, including amplitude, waviness, hybrid as well as fractal parameters. The correlation of these parameters with the machining conditions was investigated, as well as their interdependence. Observed characteristics become more pronounced, when intensifying machining conditions. Close correlation exists between surface

roughness and waviness parameters and EDM input variables. EDMed surfaces were revealed to be in view of topography: “empty”, “open”, “steep” and “random in shape” and the parameters selected express quantitatively in a satisfying manner these features.

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8. Petropoulos, P.G., Vaxevanidis, M.N., Pantazaras, N.C., and Antoniadis, T.A. (2004) **Shape control of representative turned surface textures**, Proc. 9th International Conference on Metrology & Properties of Engineering Surfaces, (eds. B.-G. Rosen and T.R. Thomas), Halmstad University, Sweden, 10-11 September 2003, Sweden, pp. 301-306.

#### Περίληψη

A method for characterizing machined surface textures corresponding to varying cutting conditions, which lead to differing profile shapes, is presented here. Through a proper multi-parameter analysis carried out on turned steel specimens, it is indicated that statistical functions and parameters are the most effective towards relative discrimination and control.

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9. Vaxevanidis, M.N., Petropoulos, P.G., and Pantazaras, N.C. (2004) **Surface properties of steel plates impacted by spherical shots**, Proc. 9th Int. Conference on Metrology & Properties of Engineering Surfaces, (eds. B.-G. Rosen and T.R. Thomas), Halmstad University, Sweden, 10-11 September 2003, Sweden, pp. 232-239.

#### Περίληψη

The present paper is focused on the evaluation of surface characteristics of steel plates impacted by spherical shots accelerated under gravity from a small height (ball dropping). The concept of “surface integrity” is adopted for this evaluation and the surface characteristics of the treated surfaces are correlated with process parameters, namely shot size, drop height and the mass of the balls dropped.

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10. Vaxevanidis, M.N., Manolakos, E.D., and Petropoulos, P.G., **Surface integrity and tribological behavior of plasma sprayed alumina coatings on steel and aluminum substrates**, Proc. 5th Int. Conf. on Tribology - BALKANTRIB '05, 15-18 June, 2005, Kragujevac, Serbia and Montenegro, pp. 229-234.

## Περίληψη

Ceramic coatings produced by thermal spray techniques are widely used to improve wear and corrosion resistance of working metal surfaces. In the present paper we report on the surface integrity states and the tribological behaviour of plasma-sprayed alumina coatings on steel and aluminum substrates. The influence of arc current employed during the spraying processes on the two previous mentioned aspects is also examined.

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11. Petropoulos, G., Pantazaras, C., Vaxevanidis, N., and Ntziantzias, I., **Selecting subsets of mutually uncorrelated surface roughness parameters in turning operations**, Proc. 11<sup>th</sup> Int. Scientific Conference on contemporary achievements in Mechanics, Manufacturing and Materials Science – CAM3S 20005, 6-9 December 2005, Giwice-Zakopane, Poland, pp. 803-808.

## Περίληψη

Due to the complexity of surface roughness profiles and the fact that different surface characteristics exist in view of function, a multi-parameter analysis of roughness is recommended by international surface metrology standard, as well as by recent research projects. The correlation of the roughness parameters with cutting conditions as well as the parameters interrelationship, constitute an important objective of investigation. The present paper describes a multi parameter surface analysis according to ISO 113565-2:1997 performed on longitudinally and face turned surfaces of Ck60 steel in order to establish subsets of mutually unrelated roughness parameters; each one of them would describe different features of the surfaces. Taking into account all cases examined, it is concluded that a minimum concise set of independent parameters towards turning process control and research would incorporate  $R_a$ ,  $R_{sk}$ ,  $R_{ku}$ , and  $R_{DelQ}$ .

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12. Markopoulos, A., Vaxevanidis, N., Petropoulos, G., Manolakos, E.D., **Artificial neural network modeling of surface finish in Electro-discharge machining of tool steels**, Proceedings of ESDA2006: 8th Biennial ASME Conference on Engineering Systems Design and Analysis, July 4-7, 2006, Torino, Italy. (paper ESDA2006-95609).

## Περίληψη

Electro-Discharge machining (EDM) is a thermal process with a complex metal removal mechanism that involves the formation of a plasma channel between the tool and the workpiece electrodes and the melting and evaporation of material



resulted thus in the generation of a rough surface consisting of a large number of randomly overlapping craters and no preferential direction. EDM is considered especially suitable for machining complex contours, with high accuracy and for materials that are not amenable to conventional removal methods. However, certain phenomena negatively affecting the surface integrity of EDMed workpieces, constrain the expanded application of the technology.

Accordingly, it has been difficult to establish models that correlate accurately the operational variables and the performance towards the optimization of the process. In recent years, artificial neural networks (ANN) have emerged as a novel modeling technique that is able to provide reliable results and it can be integrated into a great number of technological areas including various aspects of manufacturing. In this paper ANN models for the prediction of the surface roughness of electro-discharge machined surfaces are presented. A feed-forward artificial ANN trained with the Levenberg-Marquardt algorithm was finally selected. The proposed neural network takes into consideration the pulse current and the pulse-on time as EDM process variables, for three different tool steels in order to determine the center-line average ( $R_a$ ) and the maximum height of the profile ( $R_t$ ) surface roughness parameters.

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13. Chryssolouris, G., Vassilliou, El., Mavrikios, D., (2006) *Application of Information Theory to the Quantification of Concurrent Engineering Processes*, Proceedings of the 13th ISPE International Conference on Concurrent Engineering, Antibes, France, pp. 679-695.

#### Περίληψη

The paper explores the use of Information Theory for modelling the information exchange and flow in the product development process. The models developed are implemented in serial, as well as in concurrent product development. They provide a qualitative analysis of the messages exchanged through the communication channels and they lead to a comparison of the effectiveness of concurrent engineering to that of sequential. The case study is the pilot implementation of the model, based on information theory, in a bicycle manufacturing company. The results have shown that in the concurrent approach, the total development and detection times of the potential errors are reduced compared with those in the serial approach.

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14. Chryssolouris, G., Vassilliou, El., Mavrikios, D. (2006) *Application of Information Theory to the Quantification of Concurrent Engineering Processes*, στο: P. Ghodous et al (Eds) IOS Press, Leading the Web in Concurrent Engineering.

## Περίληψη

The paper explores the use of Information Theory for modelling the information exchange and flow in the product development process. The models developed are implemented in serial, as well as in concurrent product development. They provide a qualitative analysis of the messages exchanged through the communication channels and they lead to a comparison of the effectiveness of concurrent engineering to that of sequential. The case study is the pilot implementation of the model, based on information theory, in a bicycle manufacturing company. The results have shown that in the concurrent approach, the total development and detection times of the potential errors are reduced compared with those in the serial approach.

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15. Prokopiou, H., Koutsomichalis, A., Vaxevanidis, M.N., *Quality Approaches and Interventions in Greek Secondary Educations*, Proc. 2<sup>nd</sup> International Conference ICQME 2007, 12-14 September 2007, Budva, Montenegro, pp. 188-195.

## Περίληψη

The present paper is focused on the application of quality principles in Greek Secondary Education and comprises of two interrelated parts. In the first part of this work definitions, a theoretical framework and multi-models of quality in education are introduced and discussed, in brief. Next, the initiatives applied for improving the quality of education are emphasized. Since 1996 and for more than a decade, a series of ESF interventions have been applied in Greece with measurable impact on improving the quality of Greek Secondary Education. The most important policy measures focused at Secondary Education together with their results are presented in the second part of the paper.

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16. Petropoulos, P.G., Vaxevanidis, M.N., Koutsomichalis, A., and Iakovou, A., *A Topographic Description of the Bearing Properties of Electro-Discharged Machined Surfaces*, Proc. 2<sup>nd</sup> Int. Conf. on Manufacturing Engineering-ICMEN, 5-7 October 2005, Kassandra-Chalkidiki, Greece, pp. 159-166.

## Περίληψη

The present study concerns with the investigation of a set of “non–common” surface topography parameters of EDMed surfaces that describe their bearing capacity in tribological applications; a topic somehow overlooked in technical literature. The parameters considered are the Abbott (bearing) curve parameter at

10 % of the raw unfiltered and the roughness profile height Ptp10% and Rtp10%, respectively, the Rk family of parameters (DIN EN ISO 13565-2), the skewness Rsk and the kurtosis Rku of the profile height distribution and the fractal dimension D.

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17. Koutsomichalis, A., Vaxevanidis, M.N., Diamanti, A., Petropoulos, P.G., Papazoglou, T., and Antoniou, S.S., ***Tribological Behavior of Cr3C2/NiCr Composite Plasma Sprayed Coating on Mild Steel***, Proc. 5<sup>th</sup> Int. Conf. – THE Coatings, 5-7 October 2005, Kassandra-Chalkidiki, Greece, pp. 477-485.

### Περίληψη

In the present paper we report on the surface microstructure and the tribological behaviour of plasma-sprayed chromium carbide-Ni/Cr composite coating on steel substrate. This coating is highly recommended for wear resistance at high temperatures. For the evaluation of friction and wear characteristics sliding friction tests were performed on a pin-on-disc apparatus. Three different test loads were used in order to examine the influence of contact stress on tribological behaviour. Possible wear mechanisms were also studied.

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18. Vaxevanidis, M.N., Manolakos, E.D., Koutsomichalis, A., Petropoulos, P.G., Panagotas, A., Sideris, I., Mourlas, A., Antoniou, S.S., ***The Effect of Shot Peening on Surface Integrity and Tribological Behaviour of Tool Steels***, Proc. AITC-AIT 2006, Int. Conference on Tribology, 20-22 September 2006, Parma, Italy.

### Περίληψη

In the present paper we report on the effect of shot peening on the surface integrity and the tribological behaviour of tool steels (a premium AISI H13 and a modified AISI P20 grades). Shot peening of steel discs was performed by using two different shot sizes (S110 and S230) combined with two different blast pressures (40 psi and 80 psi).

For the evaluation of surface integrity parameters (surface roughness, topography and microhardness) typical standardized methods were used. For the evaluation of friction and wear characteristics sliding friction tests were performed on a state-of-the-art pin-on-disc apparatus.

Main findings are summarized as follows: (i) A surface morphology characterized by randomly overlapping craters with dimensions increasing with the increase of shot size and/or pressure was identified in all cases. (ii) A thin work-

hardened zone was developed on all specimens; the extent of this zone and the position of peak microhardness value depend upon the peening parameters. (iii) It was verified that, in general, shot peening exerts a beneficial effect on tribological behaviour reducing wear and friction coefficient.

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19. Βαξεβανίδης, Μ.Ν., και Μανωλάκος, Ε.Δ., Ομοιομορφία επιφάνειας και τριβολογική συμπεριφορά επιστρωμάτων  $Al_2O_3$  σε υποστρώματα χάλυβα και αλουμινίου, 2<sup>ο</sup> Πανελλήνιο Συνέδριο Μεταλλικών Υλικών, ΕΜΠ, 25-26/11/2004, Αθήνα, σελ.357-364.

#### Περίληψη

Στην παρούσα εργασία μελετάται η ομοιομορφία επιφάνειας και η τριβολογική συμπεριφορά επιστρωμάτων αλούμινας ( $Al_2O_3$ ) εναποτεθέντων με τη μέθοδο του ατμοσφαιρικού ψεκασμού πλάσματος σε υποστρώματα χάλυβα και αλουμινίου όπως και η επίδραση μιας παραμέτρου (ένταση ρεύματος) της διαδικασίας ψεκασμού της σκόνης στη συμπεριφορά και τις ιδιότητες του διαστρωμένου υλικού.

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20. Παπάζογλου, Θ., Μουρλάς, Α., Βαξεβανίδης, Μ.Ν., και Αντωνίου, Σ.Σ., Σύγχρονες τριβολογικές εξελίξεις στους κινητήρες των αυτοκινήτων, Πρακτικά 1ου Πανελληνίου Συνεδρίου Μηχανολόγων-Ηλεκτρολόγων, άρθρο Β117, 28-30 Μαρτίου 2005, Αθήνα.

#### Περίληψη

Η παρούσα εργασία εξετάζει τις κύριες τριβολογικές επιδράσεις στα μηχανικά μέρη του κινητήρα του αυτοκινήτου, παρουσιάζει τις τεχνικές λύσεις (σχεδιασμός, υλικά) που επιλέγονται, συνήθως σήμερα και τις πιθανές εναλλακτικές εφαρμογές. Παρουσιάζονται οι τύποι λίπανσης που συναντώνται στον κινητήρα και τα παρελκόμενά του με αναφορά στην καμπύλη Stribeck και οι απαιτήσεις των λιπαντικών που χρησιμοποιούνται αντίστοιχα. Στην συνέχεια γίνεται μια κριτική παρουσίαση των κυριότερων τριβολογικών χαρακτηριστικών των υποσυστημάτων του οχήματος. Συζητούνται οι μηχανισμοί φθοράς που εμφανίζονται σε κάθε υποσύστημα και οι τεχνολογικές λύσεις που εφαρμόζονται. Δίδεται έμφαση στα χαρακτηριστικά και τις απαιτήσεις που πρέπει να πληρούν τα λιπαντικά που χρησιμοποιούνται αλλά και στην εφαρμογή νέων υλικών ή επικαλύψεων με βελτιωμένες τριβολογικές ιδιότητες.

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21. Βαξεβανίδης, Μ.Ν., Πανταζάρας, Κ., και Πετρόπουλος, Γ., Υγρά κοπή: Διαχείριση και καθαρή κοπή, Πρακτικά 1<sup>ου</sup> Πανελληνίου Συνεδρίου Μηχανολόγων-Ηλεκτρολόγων, άρθρο Β 118, 28-30 Μαρτίου 2005, Αθήνα.

### Περίληψη

Οι κατεργασίες κοπής των μετάλλων που εφαρμόζονται στη μεταποιητική βιομηχανία είναι αναπόσπαστα συνδεδεμένες με την χρήση υγρών κοπής. Ως λιπαντικά ή/και ψυκτικά μέσα τα υγρά αυτά είναι αναγκαία για την επίτευξη του επιθυμητού παραγωγικού αποτελέσματος. Ωστόσο, η χρήση τους συνδέεται με την εμφάνιση προβλημάτων τόσο στο άμεσο περιβάλλον εργασίας όσο και στην διαχείριση/απόρριψη τους ως παραπροϊόντων της παραγωγής. Στην παρούσα εργασία παρουσιάζονται και σχολιάζονται κριτικά οι εναλλακτικές λύσεις που εφαρμόζονται σχετικά με την μείωση της χρήσης και την περιβαλλοντικά ασφαλή διαχείριση των υγρών κοπής. Τρεις κύριες κατευθύνσεις συνοψίζονται: (α) ο σχεδιασμός και εφαρμογή ενός προγράμματος διαχείρισης υγρών κοπής με έμφαση στην μείωση, την επαναχρησιμοποίηση και την ανακύκλωση των υγρών κοπής, (β) η χρήση μη συμβατικών, φυτικών και βιοδιασπώμενων υγρών κοπής και (γ) η εφαρμογή τεχνικών κοπής χωρίς την χρήση υγρών κοπής (dry machining).

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22. Πετρόπουλος, Γ., Πανταζάρας, Κ., και Βαξεβανίδης, Ν., Σημασία της τοπογραφικής ανισοτροπίας κατεργασμένων επιφανειών – παραδείγματα, Metrology 2005: 1ο τακτικό Συνέδριο Μετρολογίας, 11-12 Νοεμβρίου 2005, Αθήνα, σελ. 62-67.

### Περίληψη

Η τοπογραφία των τεχνολογικών επιφανειών παίζει σημαντικό ρόλο, τόσο στην τριβολογική λειτουργία τους, όσο και στον έλεγχο της ακολουθούμενης κατεργασίας. Η τοπογραφική ανισοτροπία ή ισοτροπία είναι ένα σημαντικό χαρακτηριστικό. Το παρόν άρθρο προβαίνει σε μια βασική ανασκόπηση υφιστάμενων μέτρων ανισοτροπίας, παρουσιάζει ένα παράδειγμα θεώρησης της ανισοτροπίας ως κριτηρίου φθοράς σε τριβοσύστημα και τελικώς προτείνει την εισαγωγή νέων δεικτών ανισοτροπίας.



## 5. Τομέας Αεροναυπηγικής, Τεχνικής Μηχανικής, Δομικών Κατασκευών – Έργων Υποδομών

1. Kehayas, N., *Aeronautical Technology for Future Subsonic Civil Transport Aircraft*, Aircraft Engineering and Aerospace Technology, Vol. 79, No. 6, 2007.

### Περίληψη

*Purpose* - Aeronautical technology is reviewed with the objective to indicate the most promising for application to future subsonic civil transport aircraft.

*Methodology* - A methodology is put forward, according to which Direct Operating Costs (DOC) are examined in order to find those that can be reduced, and, then, specific technology is assessed in relation to its efficiency in reducing these DOC, operational feasibility and cost-effectiveness.

*Findings* - This assessment suggests the selection of propfan and powered lift as the leading future aeronautical technology. These findings are supported by a comparison of a number of advanced technology designs.

*Originality/value* – Provides a starting point for further investigation of advanced aeronautical technology and unconventional configurations for large subsonic civil transport aircraft.

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2. Kehayas, N., *A Powered Lift Design for Subsonic Civil Transport Aircraft*, ICAS Paper 06-1.3 S. Hamburg, September, 2006.

### Περίληψη

It has been suggested that the basic configuration of subsonic civil transport aircraft is nearing its full evolutionary potential and a departure in the form of a new configuration or technology is needed. In this paper a jet-flap type powered lift design is being evaluated and then compared to blended wing-body and other advanced technology designs.



## 6. Τομέας Ηλεκτρονικών, Ηλεκτρικής Ισχύος και Τηλεπικοινωνιών

1. Kliros, S.G., and Divari, C.P. (2007) *Beating of the oscillations in the magnetocapacitance of a MODFET with Rasba spin-orbit interaction*, *Microelectronics Journal*, in press, doi: 10.1016/j.mejo.2007.09.005.

### Περίληψη

The effect of Rasba spin-orbit interaction (SOI) on the magnetocapacitance of the 2DEG in a MODFET is investigated. We present calculations on the density of states (DOS) of the 2DEG in a MODFET under the influence of both Rasba SOI and weak two-dimensional periodic modulation. Adopting a Gaussian broadening of magnetic-field-dependent width, we present a simple expression for the DOS, valid for the relevant weak magnetic fields and modulation strengths. In the presence of Rasba SOI and for weak potential modulation strengths, a typical beating pattern of the magnetocapacitance oscillations is observed in the low magnetic field range. A simple relation that predicts the positions of nodes in the beating patterns is obtained. The interplay between the SOI and the periodic potential modulation is discussed.

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2. Kliros, S.G., and Divari, C.P. (2007) *Magneto-capacitance of a MODFET under two-dimensional periodic potential modulation*, *Microelectronics Journal*, Vol. 38, pp. 625-631.

### Περίληψη

In this paper we present calculations on the density of states (DOS) and the magnetocapacitance of the 2DEG in a MODFET under two-dimensional (2D) weak periodic modulation in the presence of a perpendicular magnetic field. Adopting a Gaussian broadening of magnetic-field-dependent width, we present explicit and simple expressions for the DOS, valid for the relevant weak magnetic fields and modulation strengths. As the modulation strength in both directions increase, beating patterns of the magnetocapacitance oscillations are observed in the low-magnetic-field range (Weiss-oscillations regime) which are absent in the 1D weak modulation case.

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3. Kliros, S.G., and Divari, C.P. (2006) Localized Wavefunctions and Magnetic Band Structure for Lateral Semiconductor Superlattices, Int. Journal of Modern Physics B, 20 (32), pp. 5427-5442.

#### Περίληψη

In this paper we present calculations on the electronic band structure of a two-dimensional lateral superlattice subject to a perpendicular magnetic field by employing a projection operator technique based on the ray-group of magnetotranslation operators. We construct a new basis of appropriately symmetrized Bloch-like wavefunctions as linear combination of well-localized magnetic Wannier functions. The magnetic field was consistently included in the Wannier functions defined in terms of free-electron eigenfunctions in the presence of external magnetic field in the symmetric gauge. Using the above basis, we calculate the magnetic energy spectrum of electrons in a lateral superlattice with bi-directional weak electrostatic modulation. Both a square lattice and a triangular one are considered as special cases. Our approach based on group theory handles the cases of integer and rational magnetic fluxes in a uniform way and the provided basis could be convenient for further both analytic and numerical calculations.

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4. Kliros, S.G., and Andreatos, S.A. (2006) Identifying Transistor Roles in Analysis and Synthesis of Analog Integrated Circuits, WSEAS Transactions on Advances in Engineering Education, vol. 3 (5), pp. 280-288.

#### Περίληψη

Integrated circuit analysis and design is a quickly developing field which deals with many advanced technologies, but also, a difficult skill for many students in a comprehensive first course in Microelectronics. New methods and techniques to help novices learn are needed. In this paper, we use the recently introduced concept of transistor roles to distinguish different transistor configurations in typical analog integrated circuits; then we show how analog integrated circuits can be redrawn using the predefined role symbols. Transistor roles capture expert electronics engineers' tacit knowledge in a way that can be explicitly taught to students. The use of roles and role-based circuit analysis and synthesis is expected to greatly facilitate the teaching of analog integrated circuits.

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5. Kliros, S.G., and Andreatos, S.A., (2006) Using Transistor Roles in Teaching CMOS Integrated Circuits, Proc. 3<sup>rd</sup> WSEAS/IASME International Conference on Engineering Education, Vouliagmeni, Athens, Greece, July 2006.



## Περίληψη

CMOS integrated circuit analysis and design is a fast paced field which deals with many advanced technologies and a difficult skill for many students in a comprehensive first course in Microelectronics. New methods and techniques to help novices learn are needed. In this paper the transistor role concept is used and common individual CMOS transistor roles are identified. Typical circuit and block symbols have been used and some new symbols are defined. Roles of transistors capture expert electronics engineers tacit knowledge in a way that can be explicitly taught to students; therefore, roles should be taught to students in order to distinguish different transistor configurations in an integrated circuit. The use of roles and role-based circuit analysis and design is also expected to facilitate the teaching of circuit analysis and synthesis.

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6. Kliros, S.G., Liantzas, S.K., and Konstantinidis, A.A. (2007) **Modeling of Microstrip Patch Antennas with Electromagnetic Band Gap Superstrate**, 19<sup>th</sup> IEEE Int'l Conf. on Applied Electromagnetics and Communications, 24-26 September 2007, Dubrovnik, Croatia, pp. 181-184.

## Περίληψη

Microstrip patch antennas have some limitations such as restricted bandwidth of operation, low gain and a potential decrease in radiation efficiency due to surface wave losses. Electromagnetic bandgap (EBG) crystals can offer a real solution to these problems. In this paper, we have simulated the performance of a microstrip patch antenna with a square high-permittivity EBG crystal with air-columns used both as substrate and superstrate. The EBG-structure was analyzed using our implementation of the Plane Wave Expansion method in MATLAB. The input return loss, radiation pattern and the directivity of the antenna were calculated using the CST Microwave Studio transient solver based on the Finite Integration Technique (FIT). It is shown that the presence of the EBG-superstrate is very efficient for improving the far-field radiation pattern and enhances significantly the directivity of the antenna. The performance of antenna is enhanced when the superstrate is placed half operating-wavelength apart from the patch.

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7. Kliros, S.G., Liantzas, S.K., and Konstantinidis, A.A. (2006) **Radiation Pattern Improvement of a Microstrip Patch Antenna using Electromagnetic Band Gap Substrate and Superstrate**, WSEAS Transactions on Communications, Vol. 6, pp. 45-52.

## Περίληψη

Microchip patch antennas have some limitations such as restricted bandwidth of operation, low gain and a potential decrease in radiation efficiency due to surface wave losses. Electromagnetic bandgap (EBG) crystals can offer a real solution to these problems. In this paper, we have simulated the performance of a microchip patch antenna with a hexagonal low-permittivity EBG crystal used both as a substrate and a superstrate. The EBG structure was analyzed using our implementation of the Plane Wave Expansion method in MATLAB. The input return loss, radiation pattern and the directivity of the antenna were calculated using the CST Microwave Studio transient solver base on the Finite Integration Technique (FIT). The designed microstrip antenna showed significant suppression of surface modes compared to conventional patch antenna, thus improving the gain and far-field radiation pattern. It is also shown that the presence of the EBG superstrate is very efficient for improving radiation directivity. The performance of antenna as a function of frequency over the operating bandwidth as well as a function of spacing between substrate and superstrate is studied.

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8. Kliros, S.G., Konstantinidis, J., and Thraskias, C. (2006) *Prediction of Macrobending and Splice Losses for Photonic Crystal Fibers based on the Effective Index Method for Index-guiding Photonic Crystal Fibers*, WSEAS Transactions on Communications, Vol. 5, pp. 1314-1321.

## Περίληψη

An index-guiding photonic crystal fiber (PCF) with an array of air holes surrounding the silica core region has special characteristics compared to conventional single-mode fibers (SMFs). Using the effective index method and the Gaussian beam propagation theory, the macro-bending and splice losses for PCFs are investigated. The wavelength dependence of the cladding index of the PCF has been taken properly into account. We obtain the effective spot size for different configurations of PCFs, which is used for computing the splice losses. The Gaussian approximation for the fundamental modal field leads to simple closed-form expressions for the splice losses produced by transverse, longitudinal and angular offsets. Calculations of macro-bending losses are based on antenna theory for bend standard fibers.

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9. Kliros, S.G., and Divari, C.P. (2007) *Coupling characteristics of laser diodes to high numerical aperture thermally expanded core fibers*, J. Mater. Sci: Mater Electron, in press, doi: 10.1007/s10854-007-9437-8.

## Περίληψη

We numerically calculate the coupling loss coefficients of Laser Diode (LD) to high numerical aperture (HNA) thermally expanded core (TEC) fiber coupling in terms of lateral, longitudinal and angular misalignments. The propagating fields in the HNA-TEC fiber are obtained by Galerkin's method and the coupling loss coefficients are calculated by the overlap integral technique. Our numerical results are compared with recently available experimental data. It is demonstrated that, in HNA-TEC fibers the lateral and longitudinal tolerances were effectively enlarged in comparison with those of conventional SMF-28. It is also found that TEC fibers are good candidates for free-space LD-to-fiber optical coupling scheme with long working distance. However, the angular tolerance of the HNA-TEC fiber is lower than that of the SMF-28.

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10. Divari, C.P., and Kliros, S.G. (2007) *Modal and Coupling Characteristics of Low-Order Modes in Thermally Diffused Expanded Core Fibers*, *Optik: Int. J. Light Elec. Optics*, in press, doi: 10.1016/j.ijleo.2007.08.005.

## Περίληψη

In this paper, the Galerkin's numerical method is applied in order to calculate propagation constants, optical intensity distributions and far-field-patterns of low-order LP-modes in thermally diffused expanded core (TEC) fibers. The problem of efficient coupling between Gaussian laser beams and single-mode TEC-fibers is also considered. It is demonstrated that TEC fibers are good candidates for Laser source-to-fiber optical coupling scheme with long working distance. The numerical results are compared with the corresponding ones obtained by a one-parameter variational method utilizing Laguerre–Gauss functions. Galerkin's method is generally stable and more accurate when the mode is away from the cut-off region. On the other hand, the variational method provides an explicit form of the modal fields if the variational parameter is accurately determined.

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11. Divari, C.P., and Kliros, S.G. (2006) *Numerical Analysis of low-order Modes in Thermally Diffused Expanded Core Fibers*, *Proc 4<sup>th</sup> WSEAS Int. Conf. on Electromagnetics, Wireless and Optical Communications, Venice, Italy, November 20-22, 2006*, pp. 26-31.

## Περίληψη

Optical intensity distributions, cut off frequencies and propagation constants for the low-order modes of Thermally-Diffused Expanded Core (TEC) Fibers are demonstrated by numerical analysis based on Galerkin's method. A set of orthogonal Laguerre-Gauss functions is used to calculate the spectral dependence

of effective indices and mode fields of LP-modes. Results are compared with and shown to be accurately approximated by those obtained by an one-parameter variational method.

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12. Kliros, S.G., and Tsironikos, N. (2005) *Variational Analysis of Propagation Characteristics in Thermally Difused Expanded Core Fibers*, *Optik: Int. J. Light Elec. Optics*, Vol. 116, pp. 365-374.

### Περίληψη

We present a scalar variational method for the analysis of light-propagation characteristics in thermally diffused expanded core (TEC) fibers. The method leads to simple closed-form expressions regarding the mode field diameter, numerical aperture, waveguide dispersion as well as coupling losses produced by radial, longitudinal and angular misalignments. The dependence of coupling losses on the 'taper ratio' and normalized frequency is investigated and previous predictions that TEC fibers transmit light more effectively in free space over the order of millimeters, is confirmed. The coupling losses between small core diameter step-index fibers typically used in most erbium-doped fiber amplifiers and TEC-fibers is also considered.



## 7. Τομέας Πληροφορικής & Υπολογιστών

1. Ανδρεάτος, Α. (2005) Διδακτικές Προσεγγίσεις της Πληροφορικής στη Σχολή Ικάρων, Πρακτικά Γ΄ Πανελληνίου Συνεδρίου Διδακτικής της Πληροφορικής, Κόρινθος, Οκτ. 2005.

### Περίληψη

Στη Σχολή Ικάρων, λόγω της τεχνολογικής κατεύθυνσής της και του επιπέδου σπουδών, διδάσκονται πολλά (γενικά και εξειδικευμένα) μαθήματα πληροφορικής, αντίστοιχα εκείνων των ΑΕΙ. Τα τελευταία χρόνια γίνεται μια προσπάθεια αναβάθμισης της διδακτικής με την εισαγωγή νέων μεθόδων διδακτικής, και την αξιοποίηση του Διαδικτύου και των νέων τεχνολογιών πληροφορικής. Οι νέες μέθοδοι συμπεριλαμβάνουν την ενεργητική συμμετοχή των Ικάρων, την συνεργατική μάθηση, την εξατομίκευση της γνώσης, την ευρετική πορεία προς τη γνώση, την σύναψη εκπαιδευτικού συμβολαίου και τον εμπλουτισμό του εκπαιδευτικού υλικού με τη χρήση των νέων τεχνολογιών πολυμέσων και υπερμέσων.

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2. Ανδρεάτος, Α. (2006) A Framework for Website Assessment, Proc. MELECON 2006, Malaga, Spain, May 15-19, 2006.

### Περίληψη

The goal of this case study is to assess the websites of institutions similar to ours. The issues of interest are related to site structure, conformance to web design rules, content and performance. We have categorized the criteria and devised methods to measure them; we have examined the websites of interest, assessed the results and drawn conclusions, in order to improve our website look and performance.

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3. Andreatos, S.A., Kliros, S.G., (2006) Identifying Transistor Roles in Teaching Microelectronic Circuits, Proc. MELECON 2006, Malaga, Spain, May 15-19, 2006.

### Περίληψη

Transistor circuit analysis and design is a difficult skill for many students. New methods and techniques to help novices learn are needed. In this paper the transistor role concept is introduced and common individual transistor roles are identified. Typical circuit and block symbols have been used and some new symbols are defined. Roles of transistors capture expert electronics engineers tacit knowledge in a way that can be explicitly taught to students; therefore, roles should be taught to students in order to distinguish different transistor configurations in a complex circuit. The use of roles and rolebased circuit analysis and design is expected to facilitate the teaching of circuit analysis and synthesis.

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4. Kliros, S.G., and Andreatos, S.A., (2006) *Using Transistor Roles in Teaching CMOS Integrated Circuits*, Proc. 3<sup>rd</sup> WSEAS/IASME International Conference on Engineering Education, Vouliagmeni, Athens, Greece, July 2006.

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5. Kliros, S.G., and Andreatos, S.A. (2006) *Identifying Transistor Roles in Analysis and Synthesis of Analog Integrated Circuits*, WSEAS Transactions on Advances in Engineering Education, vol. 3 (5), pp. 280-288.

#### Περίληψη

Integrated circuit analysis and design is a quickly developing field which deals with many advanced technologies, but also, a difficult skill for many students in a comprehensive first course in Microelectronics. New methods and techniques to help novices learn are needed. In this paper, we use the recently introduced concept of transistor roles to distinguish different transistor configurations in typical analog integrated circuits; then we show how analog integrated circuits can be redrawn using the predefined role symbols. Transistor roles capture expert

electronics engineers' tacit knowledge in a way that can be explicitly taught to students. The use of roles and role-based circuit analysis and synthesis is expected to greatly facilitate the teaching of analog integrated circuits.

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6. **Andreatos, A., and Doukas, N., (2006) e-Xaminer: Electronic Examination System, Proc. 3<sup>rd</sup> WSEAS/IASME International Conference on Engineering Education, Vouliagmeni, Athens, Greece, July 2006.**

#### **Περίληψη**

This paper presents an automated examination system called e-Xaminer which is being developed as a pilot system supporting education at the Hellenic Air Force Academy. The exam agent composes personalised tests (html pages with forms) for each student, based on parametric problems and questions set by the instructor. Students submit their answers, which are marked via automatically generated scripts; a marking report is generated that can be reviewed by the course organiser, should this be necessary or desired. The above system is currently used to aid the educational tasks of the Hellenic Air Force Academy. It is our purpose to incorporate it to the continuing education pilot program developed by our Division for the officers of the Hellenic Air Force (HAF), on Computer and Telecommunication Networks. This program is to be administered by the Hellenic Air Force Academy and offered via the Internet to HAF officers.

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7. **Doukas, N., and Andreatos, A. (2006) Implementation of a Computer Assisted Assessment System, Proc. 10<sup>th</sup> WSEAS Int'l Conference on Computers, Vouliagmeni, Athens, Greece, July 2006.**

#### **Περίληψη**

A new automated examination system called e-Xaminer is being developed, in order to support the exam process at the Hellenic Air Force Academy. The goals of the e-Xaminer are to facilitate university-level instructors with limited computer training to administer electronically delivered tests, to minimise the student's opportunities for cheating during examinations and, of course, to save the time spent in manual grading. The instructor composes a document with the exam questions, in a user-friendly environment which requires only basic computer literacy skills. The e-Xaminer uses this document as input to produce an html form containing the test and a marking agent. The exam is delivered to the students via the local intranet and the students submit their answers. The marking agent marks the submitted answers and produces a marking report which is reviewed and approved by the instructor. If necessary, the process can be re-iterated. This paper

describes the design and implementation issues which were confronted during the realisation of some critical parts of this system.

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8. **Andreatos, A.S., and Doukas, T.N. (2006) The “e-Xaminer” approach: a proposed electronic examination system, WSEAS Transactions on Advances in Engineering Education, vol. 3 (5), pp. 431-438.**

### **Περίληψη**

This paper presents an automated examination system called e-Xaminer which is used for computer-assisted assessment (CAA) at the Hellenic Air Force Academy. E-Xaminer incorporates some special features which are hard to find in other CAA systems, either experimental or commercial, such as countermeasures against cheating and partial credit. E-Xaminer supports a rich set of question and problem types, which make it suitable for assessing engineering courses. Using this set we have been able to successfully transfer conventional paper-and-pencil exams in electronic format.

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9. **Doukas, T.N., and Andreatos, S.A. (2006), Implementation of a Computer Aided Assessment System based on the Domain Specific Language approach, WSEAS Transactions on Advances in Engineering Education, vol. 3(5), 382-388.**

### **Περίληψη**

A purpose-built computer aided assessment (CAA) system is being developed, to be used for supporting teaching at the Hellenic Air Force Academy (HAFA). This paper presents the aims of this research and explains the design and the technical approach followed in confronting certain issues which arose during the early stages of the development. The new system uses the Domain Specific Language abstraction to facilitate its use by teaching staff which possesses only basic computer literacy skills. The research also aims to overcome technical issues related to implementing new marking schemes which will allow the automated marking process to approach the flexibility and fairness of manual marking, while reducing the time required. Towards this goal, the new system uses various tactics to overcome the problems encountered when trying to automatically assess free-text style answers. It also tries to mimic the instructors' ability to give partial credit for partially complete answers (even numeric ones). The new system explores algorithms that can be employed for analyzing the students' answers, given the particularities of the Greek language and the special requirements of teaching at the Hellenic Air Force Academy. Finally, by reducing the students' opportunities for



cheating during exam time, the new system helps reduce the need for exam time supervision and hence helps relax the stress of examinations and promote the learning process.

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10. Ανδρεάτος, Α., και Δούκας, Ν. (2005) *e-Xaminer: Σύστημα αυτόματης και εξατομικευμένης εξέτασης και βαθμολόγησης*, 5<sup>ο</sup> Πανελλήνιο συνέδριο ΕΤΠΕ, Θεσσαλονίκη, Οκτώβριος 2005.

#### Περίληψη

Στην εργασία μας παρουσιάζουμε ένα σύστημα αυτόματης εξέτασης και βαθμολόγησης διαγωνισμάτων που αναπτύχθηκε και χρησιμοποιείται από τον Τομέα Πληροφορικής της Σχολής Ικάρων. Για τη χρήση του προγράμματος δεν απαιτείται καθόλου γνώση γλωσσών προγραμματισμού παρά μόνον μετατροπή των ερωτήσεων, των προβλημάτων και των απαντήσεων σε τυποποιημένη ηλεκτρονική μορφή. Το πρόγραμμα e-Xaminer υποστηρίζει μια ποικιλία εννέα ερωτήσεων και προβλημάτων, πράγμα που δίνει στον εξεταστή μεγάλη ευελιξία στην σχεδίαση του διαγωνίσματος. Ο e-Xaminer δίνει την δυνατότητα εξατομικευμένης εξέτασης μέσω ενός τύπου προβλημάτων που επιδέχονται παραμετροποίηση βάσει του αριθμού μητρώου του εξεταζόμενου ή τυχαίων αριθμών.

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11. Ανδρεάτος, Α. (2006) *Informal learning in virtual communities*, Proceedings of the 1<sup>st</sup> Int'l conference on Virtual Learning, ICVL 2006, Bucharest, Romania, Oct. 2006.

#### Περίληψη

This paper deals with the concept of atypical, informal learning in virtual communities on the Internet. We focus on some specific kinds of communities and examine how they operate, how their members interact, what values they share, what kind of knowledge they gather and their social impact. Virtual communities are then compared to real-life communities. We subsequently focus on the learning process within virtual communities. We examine what kind of information and knowledge is available in some particular virtual communities, how it is gathered, organized and spread among their members. Finally, the learning process of virtual communities is compared to that of Open Universities. Several case studies are employed.

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12. Doukas, T.N., and Andreatos, S.A. (2006) *e-Xaminer: An automated system for electronic test delivery and assessment*", in Proc. Int'l conference on Virtual Learning, ICVL 2006, Bucharest, Romania, Oct. 2006.

### Περίληψη

This paper describes an automated system for the delivery of tests and the assessment of performance of students. The system, called e-Xaminer, has been developed for use in both undergraduate courses and distance learning programs of the Hellenic Air Force Academy. e-Xaminer uses meta-language concepts to automatically generate tests, based on parametrically designed questions which are set by the course organisers. Tests intended for different students may entail differences in the arithmetic parameters or different sub-questions, from a set of equivalent ones, or may just present each student with a scrambled sequence of questions. Examinations are delivered via a web-based interface; an automatically generated program marks the answers submitted by each student. This paper focuses on the implementation of question parameterisation and counter cheating measures. Sample tests are presented which show the additional features of the e-Xaminer, intended to facilitate the work of the course organiser in issuing and marking the tests, as well as in combating cheating. Results and conclusions from tests given during the past academic year are presented and conclusions are drawn. The directions for planned future work are outlined.

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13. Ανδρεάτος, Α., *Virtual communities and their importance for informal learning*, IJCCC, vol. 2 (1), pp. 39-47. <http://journal.univagora.ro/download/pdf/69.pdf> .

### Περίληψη

This paper deals with the concept of informal learning in virtual communities on the Internet. Initially we discuss the need for continuing education and its relation with informal learning. Virtual communities are next defined and then compared to real communities. Case studies are employed, focused on some specific kinds of virtual communities. We examine how they operate, how their members interact, what values they share and what kind of knowledge they gather. The learning process within virtual communities is then examined. We look at the kind of information and knowledge available in some particular virtual communities, and comment on its organisation. Next, the learning process of virtual communities is compared to that of Open Universities. Finally, we claim that the participation in virtual communities is not only a form of continuing education but also a contribution towards the multiliteracies needed for working as well as living in the 21st century.

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14. Doukas, T.N., and Andreatos, S.A., *Advancing electronic assessment*, IJCCC, vol. 2 (1), pp. 56-65. <http://journal.univagora.ro/download/pdf/71.pdf> .

### Περίληψη

A computer-aided assessment system is presented that has been designed to produce and deliver tests to the Hellenic Air Force Academy students and assess their performance. The system is called e-Xaminer and is intended for use in both undergraduate courses and distance learning post-graduate programs of the Academy. The e-Xaminer uses meta-language concepts to automatically generate tests, based on parametrically designed questions. Tests intended for different students may entail differences in the arithmetic parameters. Additionally, different tests may be composed from different but equivalent and randomly chosen sub-questions. The system may also present each student with a scrambled sequence of the same questions, as a counter-measure against cheating. Examinations are delivered via a webbased interface; an automatically generated program marks the answers submitted by each student. e-Xaminer allows the implementation of question parameterisation and counter cheating measures, so that electronic tests become significantly different and more powerful than traditional ones. Sample problems are presented which show the additional features of the e-Xaminer, intended to facilitate the work of the course organizer in issuing and marking the tests, as well as in combating cheating. This paper focuses on some new, advanced types of questions enabled by electronic assessment; it then compares paper-and-pencil exams to electronic exams; results from a small student poll on the electronic exams are also presented. Finally, the directions for planned future work are outlined.

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15. Andreatos, A., & Stefaneas, P. (2007) *Interactive Educational Television: A Digital Bridge for the Knowledge Gap?*, Proceedings of EDEN 07, June 2007, Naples, Italy.

### Περίληψη

The Knowledge Gap Hypothesis [Tichenor et al., 1970] is one of the approaches to interpret the digital divide. The main argument is that when the flow of information in a social system increases, this benefits more the citizens with higher education, social and economic status than the ones with lower one; thus, the increase on the amount of information makes the gap wider between the information rich and the information poor people. Philip Tichenor and his collaborators proposed the concept for the first time in 1970. They used data from the American Institute of Polls (American Institute of Public Opinion) between 1949 and 1965. One of the questions was if the people believed that the man will reach in the moon one day.

They collected answers to the same question in four different years (1949, 1954, 1959 and 1965). The result was that those with higher level of education was much more likely to consider that the person will arrive at the moon than those with lower level of education and that gap was increased over the years

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16. **Andreatos, A. (2007) On Evaluating the Quality of Computer-Supported Collaborative Learning, Proceedings of EDEN 07, June 2007, Naples, Italy.**

#### **Περίληψη**

Collaborative Learning is a coordinated, synchronous and interactive activity of joint problem solving, where partners attempt to construct and maintain a shared conception of a problem in order to solve it in common; learning is expected to occur as a result and/or a side-effect of problem solving. This learning is measured by the elicitation of new knowledge or/and by the improvement of problem solving skills of the partners [Dillenbourg, 1999].

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17. **Andreatos, A. (2007) Electronic exams for the 21st century, Proc. 1st European Computing Conference, (IARAS), Athens, Greece, Sept. 2007.**

#### **Περίληψη**

ICT has deeply affected the way people in modern societies get educated and learn new things. Several 'digital skills' are needed for young people in order to live and work in the 21st century. During the years to come, a tremendous development and spread of e-learning and consequently e-assessment, is expected. Common question types used to-day will soon prove inadequate to assess the required 'digital skills'. In this paper we deal with this problem and we propose some solutions.

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18. **Ανδρέατος, Α. (2007) Η συνεργατική μάθηση στα πλαίσια της ΑεξΑΕ, ICODL 2007, 4<sup>ο</sup> Διεθνές Συνέδριο Ανοικτής και εξ Αποστάσεως Εκπαίδευσης – Μορφές Δημοκρατίας στην Εκπαίδευση, Αθήνα, 23 -25 Νοεμβρίου 2007.**

#### **Περίληψη**

Στο άρθρο αυτό αρχικά συγκρίνουμε -μέσω ενός απλού θεωρητικού μοντέλου πέντε συνιστωσών- την συμβατική και την Ανοικτή και εξ Αποστάσεως εκπαίδευση

(ΑεξΑΕ). Από την σύγκριση διαφαίνεται η ανάγκη αναβαθμισμένων απαιτήσεων από το διδακτικό υλικό της ΑεξΑΕ, αλλά και από τον ίδιο τον εκπαιδευόμενο. Αναδεικνύονται επίσης κάποια κενά που δημιουργούνται λόγω της αποστάσεως στην κοινωνική διάσταση της εκπαιδευτικής διαδικασίας. Στη συνέχεια γίνεται μια σύντομη αναφορά στην κοινωνική διάσταση της εκπαιδευτικής διαδικασίας. Ενδεικτικά αναφέρεται μια μελέτη περίπτωσης της επικοινωνίας φοιτητών μιας Θ.Ε. του ΕΑΠ. Διαπιστώνεται ότι το κενό της κοινωνικής διάστασης (που στην παραδοσιακή εκπαίδευση καλύπτεται από τις μεταξύ συμφοιτητών σχέσεις), στην ΑεξΑΕ (τείνει να) συμπληρώνεται από αντίστοιχους μηχανισμούς επικοινωνίας και συνεργασίας εξ αποστάσεως. Αυτοί οι μηχανισμοί, στο βαθμό που εμφανίζουν συγκεκριμένα χαρακτηριστικά, μπορούν να χαρακτηρισθούν ως μηχανισμοί 'άτυπης συνεργατικής μάθησης'. Η μελέτη αναδεικνύει, εκτός από τις εκπαιδευτικές και μαθησιακές διαστάσεις, και τις πτυχές της κοινωνικής διάστασης της μάθησης. Τέλος προτείνεται η συνεργατική μάθηση ως επίσημο συμπλήρωμα της ΑεξΑΕ για μια πληρέστερη διδακτική εμπειρία και εξετάζονται τα οφέλη που θα προκύψουν από την επίσημη εφαρμογή της συνεργατικής μάθησης στην ΑεξΑΕ.

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19. **Andreatos, A., & Avouris, N. (2007) Analysing collaborative problem solving activities with Synergo, ICODL 2007, 4<sup>ο</sup> Διεθνές Συνέδριο Ανοικτής και εξ Αποστάσεως Εκπαίδευσης – Μορφές Δημοκρατίας στην Εκπαίδευση, Αθήνα, 23 -25 Νοεμβρίου 2007.**

### **Περίληψη**

This paper deals with the analysis of Computer-Supported Collaborative Learning activities. A pilot study conducted on adult students of the Hellenic Open University, is presented in the Introduction. Next we deal with the definition of Collaborative Learning, as well as, Computer-Supported Collaborative Learning (CSCL); we examine how CSCL works and what are the special cognitive mechanisms associated with it. We then present a set of the most commonly used criteria for evaluating the quality of CSCL. Next, a method for analysing collaborative activities is demonstrated. As a CSCL tool we use Synergo, a freeware research tool developed by the HCI group of the Univ. of Patras. Synergo is used for supporting the collaboration as well as for recording and analysing synchronous collaborative activities. A typology based on the higher cognitive mechanisms encountered in collaboration sessions is introduced; based on this typology, we can analyse collaboration sessions qualitatively; then using statistics (which are automatically produced by Synergo) we can also analyse collaboration sessions quantitatively.



## 8. Τομέας Αυτομάτου Ελέγχου, Αεροδιαστημικής Τεχνολογίας, Αμυντικών Συστημάτων & Επιχειρήσεων

1. Uzunoglou, K.N., Geroulis, G., (2007) *ESM and ECM Antennas*, στο John L. Volakis (ed.), *Antenna Engineering Handbook*.

### Περίληψη

The use of electronic countermeasures (ECM) against opponents' communications systems and monitoring of nonfriendly transmissions started with the use of wireless communications in military operations at the beginning of the 20th century. However, extensive electronic interception of nonfriendly signals and countermeasures against both communications links (primarily of high frequency [HF] at that time) and newly developed radar systems began during World War II (1939–45). The use of electromagnetic spectrum in military operations was defined as “electronic warfare” and soon the involved activities were classified as electronic support measures (ESM), consisting of passive measurements of emitted signals by nonfriendly emitters, and ECM systems, including primarily the emission of signals to confuse or deceive the communications and radar sensor systems of opposing forces.

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2. Stratakos, Y., Geroulis, G., Uzunoglou, N., (2005) *Analysis of Glint Phenomenon in a Monopulse Radar in the Presence of Skin Echo and Non-Ideal Interferometer Echo Signals*, *J. of Electromagn. Waves and Appl.*, Vol. 19, No. 5, 697–711.

### Περίληψη

Angle tracking noise in monopulse tracking radars has been an important study topic during the last decades. This phenomenon otherwise known as “Glint” is studied in present article assuming the presence of a non-perfect interferometer transponder placed on a target with a non-zero radar cross section. The effects of interferometer angle and amplitude balance and the target echo signal strength is analyzed theoretically and numerical results are computed and presented for a wide set of parameter values. The required power ratio of interferometer and echo signals to achieve significant angle noise is derived. Numerical results and analytical approximations of the angle noise are presented in the form of parametric curves.

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3. Γερούλης, Γ., (2004) **«Εθνικός Φορέας Πιστοποίησης Αμυντικών Προϊόντων» Το Μεγάλο Έλλειμμα στην Αναπτυξιακή Πορεία της Αμυντικής Βιομηχανίας της Χώρας**, The Eco Q Defense Forum, Athens.

#### Περίληψη

Η πιστοποίηση ενός αμυντικού προϊόντος αποτελεί την βασική προϋπόθεση για την προώθησή του στην αγορά ή την ενσωμάτωσή του σε μία πλατφόρμα, επίγεια, θαλάσσια ή εναέρια. Οι προβλεπόμενες διαδικασίες πιστοποίησης διασφαλίζουν στον χρήστη μεταξύ των άλλων την ασφαλή λειτουργία και την διαλειτουργικότητα του προϊόντος με τα λοιπά συστήματα της πλατφόρμας που τοποθετείται. Αν και τελευταία η αμυντική μας βιομηχανία και τα ερευνητικά ιδρύματα έχουν να παρουσιάσουν και πολλά εντυπωσιακά προϊόντα, αλλά και πολλές προτάσεις συνεργασίας με ξένες εταιρείες για κάλυψη αμυντικών αναγκών, δυστυχώς η έλλειψη αρμόδιου εξειδικευμένου εθνικού φορέα τους στερεί την δυνατότητα υλοποίησης αυτών των προγραμμάτων, ιδιαίτερα στην ΠΑ, όπου η πιστοποίηση είναι συνυφασμένη με την ασφάλεια των πτήσεων με ότι αυτό συνεπάγεται. Για τον λόγο αυτό στην παρούσα εργασία δίδεται μεγαλύτερη έκταση στον τομέα αυτό. Η έλλειψη αυτή όχι μόνο επιβαρύνει σημαντικά τις αμυντικές δαπάνες, αλλά ενισχύει και την εξάρτηση από ξένα κέντρα, και ευνοεί τα μονοπωλιακά ή ολιγοπωλιακά προμηθευτικά κέντρα με γνωστά επακόλουθα. Είναι καιρός να δημιουργηθεί ο φορέας αυτός, ώστε να ενισχυθούν οι εθνικές κατασκευαστικές δυνατότητες, οι προοπτικές για ενσωμάτωση σε αεροσκάφη, πλοία, άρματα κλπ, Ελληνικών υποσυστημάτων που θα πιστοποιούνται στη χώρα. Πολλές περιπτώσεις εφαρμογής αυτής της πρότασης αντλούνται από το ισχύον ΕΜΠΑΕ. Σήμερα η ΓΓΟΣΑΕ έχει ορισμένες δυνατότητες και αρμοδιότητες. Οι απαιτούμενες όμως δυνατότητες και ικανότητες του προτεινόμενου φορέα πρέπει να είναι κατ' ελάχιστον αυτές που αναφέρονται στην παρουσίαση αυτή και να σχετισθούν με ένα κέντρο προσομοίωσης – αξιολογήσεων και δοκιμών. Ήρθε η ώρα το μεγάλο έλλειμμα να καλυφθεί με ένα καλοσχεδιασμένο φορέα του ΥΕΘΑ που θα εκμεταλλευθεί την διαθέσιμη στη χώρα τεχνογνωσία και υψηλού επιπέδου προσωπικό.

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4. Γερούλης, Γ., **«Σύγχρονες Μέθοδοι Βελτίωσης της Παθητικής Άμυνας» - Πολλαπλασιαστές Ισχύος Χαμηλού Κόστους για την Εκτεταμένη Αεράμυνα και Τεχνολογική Πρόκληση για την Αμυντική Βιομηχανία.**

#### Περίληψη

Η αποτροπή, η ενεργητική άμυνα, η δυνατότητα αντεπίθεσης και η παθητική άμυνα, αποτελούν σήμερα τους τέσσερις βασικούς τομείς της συνολικής άμυνας, μιας χώρας. Η επιχειρησιακή της αποτελεσματικότητα δύναται να αυξηθεί δραστικά

με την εφαρμογή ισχυρής, πρωτότυπης και τακτικά και τεχνολογικά σύγχρονης παθητικής άμυνας, ενώ ταυτόχρονα δύνανται να μειωθεί σημαντικά το συνολικό της κόστος, με την αξιοποίηση συγκεκριμένων μεθόδων, τακτικών και τεχνολογικών επιτευγμάτων. Η εργασία αυτή εξετάζει τις εφαρμοζόμενες σύγχρονες τεχνολογίες και επιθετικές τακτικές που επιδιώκουν την παρατήρηση, τον εντοπισμό, τον εγκλωβισμό και την καθοδήγηση όπλων για την καταστροφή των φιλίων δυνάμεων και αντιπροτείνει μεθόδους απόκρυψης, παραλλαγής και παραπλάνησης των οπλικών συστημάτων του αντιπάλου, ώστε να αυξάνει ο δείκτης επιβίωσης των ημετέρων μέσων και εγκαταστάσεων. Παράλληλα προτείνει σειρά από μέτρα και μεθόδους που στοχεύουν αφενός στην βελτίωση της εφαρμοζόμενης παθητικής άμυνας και αφετέρου αποτελούν ενδεχόμενα κατασκευαστικά προγράμματα για την αμυντική βιομηχανία.

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5. Γερούλης, Γ., Εθνική Στρατηγική Στρατιωτικής Ισορροπίας στα Βαλκάνια, Περίληψη εργασίας ΕΛ.Ε.Σ.ΜΕ. με θέμα ΣΤΡΑΤΗΓΙΚΗ '99' – ΑΜΥΝΤΙΚΑ ΠΡΟΓΡΑΜΜΑΤΑ

#### Περίληψη

Η ανάλυση των παραγόντων που συντελούν στη σταθερότητα της περιοχής της Βαλκανικής, ο προσδιορισμός του είδους και η εκτίμηση του βαθμού (stability rate) της επικρατούσης σήμερα κατάστασης και η εκτίμηση του βαθμού επίδρασης των διατιθέμενων Ε.Δ. στην διατήρηση διαρκούς σταθερότητας, ώστε να επιλεγεί ανάλογη εθνική στρατηγική.





## 9. Τομέας Θερμοδυναμικής, Πρωθητικών & Ενεργειακών Συστημάτων

1. **Templalexis, I., Pilidis, P., Guindeuil, G., Kotsiopoulos, P., Aero engine axi-symmetric convergent – constant area intake 3D simulation using a panel method approach, Proc. ASME Turbo Expo 2005, Power for Land, Sea and Air, June 6-9, 2005, Reno-Tahoe, Nevada, USA.**

### Περίληψη

This study has been carried out as a part of a general effort to develop a powerful simulation code, based on the Vortex Lattice Method (VLM), capable of simulating adequately accurate and comparatively fast, internal flow regimes. It utilizes a convergent - (nearly) constant area axi-symmetric intake three dimensional geometry, emerged as a surface of revolution from the CFM56-5B2 lower lip geometry. The study focuses on the three most critical planes, which are the inlet of the intake, the outlet of the diverging section and the outlet of the intake. Moreover, the sensitivity of the simulation on the variation of the Angle Of Attack (AOA) is tested for four different settings equally spaced, ranging from 0 to 20 degrees. The comparison is carried out on both two-dimensional velocity distributions and average values. The VLM simulation code was based on an existing code, which was modified in order to be adapted to the Reynolds Average Navier-Stokes (RANS) Computational Fluid Dynamics (CFD) boundary conditions.

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2. **Pachidis, V., Pilidis, P., Templalexis, I., Alexander, Th., Kotsiopoulos, P., Prediction of engine performance under compressor inlet flow distortion using streamline curvature, Proc. ASME Turbo Expo 2006, Power for Land, Sea and Air, May 8-11, 2006, Barcelona, Spain.**

### Περίληψη

Traditionally, engine performance has been simulated based on non-dimensional maps for compressors and turbines. Component characteristic maps assume by default a given state of inlet conditions which can not be easily altered in order to simulate two-dimensional or three-dimensional flow phenomena. Inlet flow distortion, for example, is usually simulated by applying empirical correction factors and modifiers to default component characteristics, alternatively, the parallel compressor theory may be applied. The accuracy of the above methods has been rather questionable since they are unable to capture in sufficient fidelity component-level, complex physical processes and analyze them in the context of the whole engine performance.

The technique described in this paper integrates a zerodimensional (non-dimensional) gas turbine modeling and performance simulation system and a two-dimensional, streamline curvature compressor software. The twodimensional compressor software can fully define the characteristics of a compressor at several operating condition and is subsequently used in the zero-dimensional cycle analysis to provide a more accurate, physics-based estimate of compressor performance under clean and distorted inlet conditions, replacing the default compressor maps. The highfidelity component communicates with the lower fidelity cycle via a fully automatic and iterative process for the determination of the correct operating point.

This study discusses in detail the development, validation and integration of the two-dimensional, streamline curvature compressor software and presents the various loss models used in the code. It also discusses the relative changes in the performance of a two-stage, experimental compressor with different types of radial pressure distortion obtained by running the two-dimensional streamline curvature compressor software independently. Moreover, the performance of a notional engine model, utilizing the coupled, two-dimensional compressor, under distorted conditions is discussed in detail and compared against the engine performance under clean conditions.

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3. **Melloni, L., Kotsiopoulos, P., Pilidis, P., Pachidis, V., Jackson, A. (2006) Military Engine Response to Compressor Inlet Stratified Pressure Distortion by an Integrated CFD Analysis, Proceedings of ASME 2006 Turbo & Expo: Power for Land, Sea and Air, May 2006, Barcelona, Spain.**

### **Περίληψη**

Especially in aircraft applications, the inlet flow is quite often non uniform resulting in severe changes in compressor performance and hence, engine performance. The magnitude of this phenomenon can be amplified in military engines due to the complex shape of intake ducts and the extreme flight conditions.

The usual approach to engine performance simulation is based on non-dimensional maps for compressors and turbines and assumes uniform flow characteristics throughout the engine. In the context of the whole engine performance, component-level, complex physical processes, such as compressor inlet flow distortion, cannot be captured and analyzed.

This work adopts a simulation strategy that allows the performance characteristics of an engine component, resolved from a detailed, high-fidelity analysis, to be transferred to an engine system analysis carried out at a lower level of fidelity. The methodology described in this paper utilizes an object-oriented, zero-dimensional gas turbine modeling and performance simulation system and a high-fidelity, three-dimensional, computational fluid dynamics (CFD), low-pressure compressor model. The CFD model is based on the overall geometry and performance of the

low-pressure compressor of a modern, two-spool, low by-pass ratio (LBR) military turbofan engine and is subjected to both clean and distorted inlet flows.

The analysis involves the generation of two characteristic maps for the first stage of the LP compressor from CFD simulations that account for a range of operating conditions and power settings with a uniform and a distorted inlet flow. The same simulation strategy could be adopted for other engine components such as the intake or the high-pressure compressor and for different magnitudes and types of distortion (i.e. radial, circumferential). By integrating the CFD-generated maps, into the 0-D engine analysis system, this paper presents a relative comparison between the 'uniform-inlet' engine performance (baseline compressor stage map) and the engine performance obtained after using the map accounting for a typical extent of stratified inlet distortion. The analysis carried out by this study, demonstrates relative changes in the simulated engine performance larger than 1%.

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4. **Templalexis, I., Pilidis, P., Pachidis, V., Kotsiopoulos, P. (2006) Quasi-Three-Dimensional Compressor Performance Simulation Using Streamline Curvature And Multi-Parallel Compressor Theory, Proceedings of ASME 2006 Turbo & Expo: Power for Land, Sea and Air, May 2006, Barcelona, Spain.**

### **Περίληψη**

Engine inlet distortion can severely affect compressor performance by causing the non-dimensional speed lines and surge line to shift. This paper discusses a highly integrated method for modelling engine inlet total pressure distortion and predicting compressor performance under these conditions. This study utilizes a three dimensional (3D), computational fluid dynamics (CFD) tool, based on vortex lattice theory, to simulate the development of distorted flow within the intake and to establish the boundary conditions at the compressor's inlet face. The derived 3D pressure distributions at the intake outlet are subsequently decomposed into circumferential and radial pressure profiles. Circumferential and radial distortions are examined separately. The influence of the first profile type on compressor performance is assessed with the support of a multi-parallel compressor calculation procedure. The impact of the radial distortion profile is assessed by using a two-dimensional (2D) streamline curvature (SLC) software. Concerning the radial distortion, several distributions are examined along with various profile types. The circumferential total pressure distortion patterns addressed, are varied with respect to the spoiled sector extend and the absolute value in total pressure difference. More precisely, three spoiled sector angles of 60, 120 and 180 degrees are examined. This work demonstrates the applicability of the method by using a generic intake model fitted in front of a single stage compressor, as a case study. All the individual simulation tools, namely the intake flow simulation code, the SLC code and the multi-parallel compressor code, are briefly presented in this paper with more focus on the SLC software, which has not been published before. All

simulation tools, used by this study, have been validated individually in the past against experimental data. Their combined operation however, as a unified simulation package, has not been validated yet and hence, numerical results presented in this study should be taken qualitative.

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5. **Templalexis, I., Pilidis, P., Pachidis, V., Kotsiopoulos, P. (2007) A Fast Gas Turbine Engine Performance Analysis Tool Able to Capture Three Dimensional Effects, Proceedings of ASME 2007 Turbo & Expo: Power for Land, Sea and Air, May 2007, Montreal, Canada.**

### **Περίληψη**

Given the current level of computational resources that are readily available, three dimensional (3-D) gas turbine engine performance simulation remains extremely time consuming. The current paper presents a synthesis of existing flow simulation methods coupled together in the form of a new software package. The software is able to assess the impact of a 3-D flow profile at the intake inlet on engine performance, demanding relatively low computational resources. More precisely four flow simulation techniques are employed, represented respectively by four individual stand alone software sub-modules. 3-D Vortex Lattice Method (VLM) is used to simulate the intake flow. Subsequently the intake outlet 3-D flow profile is decomposed into a radial and a circumferential component. For the compressor performance simulation, that receives those components as inlet boundary conditions, a two dimensional (2-D) Streamline Curvature (SLC) simulation method coupled with an extended parallel compressor model is used. SLC addresses the impact of the radial flow distortion, whereas the extended parallel compressor model examines the impact of circumferential flow distortion on engine performance. The results of the above analysis are stored into an intake-compressor performance characteristic map, which is then fed into a zero dimensional (0-D) performance simulation tool in order to evaluate the overall impact of the intake inlet distorted flow on engine performance.

The paper is divided into two major sections. The first one presents the individual flow simulation techniques, together with the corresponding software modules. A short summary of each method is given first and then the software module is described, followed by brief comments on the validation results that have been already published. The section is concluded by the description of the synthesized software. The second major section deals with the application of the synthesized simulation method on a turbojet engine. A generic turbojet engine has been chosen mounted behind a generic intake, given the lack of relevant experimental results. The engine has a four stage axial flow compressor driven by a single stage axial flow turbine, followed by a converging nozzle. 3-D total pressure profiles were imposed at the intake inlet and several comparative graphs of engine's performance parameters between "clean" and distorted inlet flow conditions are given.

The paper is concluded with a discussion on software's abilities and weaknesses as well as on its potential future expansion.

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6. **Templalexis, I., Pilidis, P., Kotsiopoulos, P., Pachidis, V. (2006) Development of a 2-D compressor streamline curvature code, Proceedings of ASME 2006 Turbo & Expo: Power for Land, Sea and Air, May 2006, Barcelona, Spain.**

### **Περίληψη**

Two-dimensional compressor flow simulation software has always been a very valuable tool in compressor preliminary design studies, as well as in compressor performance assessment, operating under uniform and non-uniform inlet conditions. In this context, a new streamline curvature (SLC) software has been developed capable of analyzing the flow inside a compressor in two dimensions. The software was developed to provide great flexibility, in the sense that it can be used as: a) A performance prediction tool for compressors of a known design, b) A development tool to assess the changes in performance of a known compressor after implementing small geometry changes, c) A design tool to verify and refine the outcome of a preliminary compressor design analysis, d) A teaching tool to provide the student with an insight of the two-dimensional flow field inside a compressor and how this could be effectively predicted using the SLC method, combined with various algorithms and loss models, e) A 2-D compressor model that can be integrated into a conventional 0-D gas turbine engine cycle simulation code for the investigation of the influence of non-uniform radial pressure profiles on whole engine performance. Apart from describing in detail the design, structure and execution of the SLC software, this paper also stresses the importance of developing robust, well thought-out software and highlights the main areas a potential programmer should focus on in order to achieve this. This manuscript highlights briefly the programming features incorporated into the development of software before continuing to explain the internal workings of individual algorithms. The paper reviews in detail the set of equations used for the prediction of the meridional flow field. Numerical aspects of the application procedure of the full radial equilibrium equation are examined. The loss models incorporated for subsonic and supersonic flow are presented for design and off design operating conditions. Deviation angle rules are presented, together with the parameters for quantifying the diffusion process. Moreover, the methods used for the prediction of surge and choke are discussed in detail. Finally, the end wall boundary layer displacement thickness calculation is discussed briefly, in conjunction with the blockage factor computation. The code has been validated against experimental results which are presented in this paper together with the strong and weak points of this first version of the software and the potential for future development.

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7. **Templalexis, I., Pilidis, P., Guindeuil, G., Lekas, Th., Pachidis, V., 3D Simulation of a Convergent-Divergent Aero Engine Intake, Using Two Different CFD Methods, Proceedings of ASME 2005 Turbo & Expo: Power for Land, Sea and Air, June 2005, Reno-Tahoe, Nevada USA.**

### **Περίληψη**

This study refers to the development and validation of a Three Dimensional (3D) Vortex Lattice Method (VLM) to be used for internal flow case studies and more precisely aero-engine intake simulation. It examines the quantitative and qualitative response of the method to a convergent - divergent intake, produced as a surface of revolution of the CFM56-5B2 upper lip geometry. The study was carried out for three different sections namely: Intake outlet, intake throat and intake inlet. Moreover five different settings of Angle Of Attack (AOA) were considered. The VLM was based on an existing code. It was modified to accommodate internal flow effects and match, as closely as possible, the boundary conditions set by the Reynolds Average Navier-Stokes (RANS) Computational Fluid Dynamics (CFD) simulation. In the context of this study, Vortex Lattice-derived average values velocity profiles were compared against RANS CFD results.

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8. **Pachidis, V., Pilidis, P., Templalexis, I., Marinai, L., (2007) An iterative Method for blade profile loss model adaptation using streamline curvature, Proceedings of ASME 2007 Turbo & Expo: Power for Land, Sea and Air, May 2007, Montreal, Canada.**

### **Περίληψη**

The various incidence, deviation and loss models used in through-flow analysis methods, such as Streamline Curvature, are nothing more than statistical curve fits. A closer look at public domain data reveals that these statistical correlations and curve fits are usually based on experimental cascade data that actually display a fairly large scatter, resulting in a relatively high degree of uncertainty. This usually leads to substantial differences between the calculated and actual performances of a given gas turbine engine component.

Typically, matching calculated results from a throughflow analysis against experimental data requires the combination of various correlations available in the public domain, through a very tedious, complex and time consuming 'trial and error' process.

This particular study supports the view that it might actually be much more time-effective to "adopt" a given loss model against experimental data through an iterative, physicsbased approach, rather than try to identify the best combination of

available correlations. For example, the well-established “Swan's model” for calculating the blade profile loss factor in subsonic and transonic axial flow compressors depends strongly on approximate correlations for calculating the blade wake momentum thickness, and therefore represents such a case.

This study demonstrates this by looking into an iterative approach to blade profile loss model adaptation that can provide a relatively simple and quick, but also physics-based way of ‘calibrating’ profile loss models against available experimental data for subsonic applications.

This paper presents in detail all the analysis necessary to support the above concept and discusses Swan's model in particular as an example. Finally, the paper discusses the performance comparison of a two-dimensional, Streamline Curvature compressor model against experimental data before and after the adaptation of that particular loss model.

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9. **Pachidis, V., Pilidis, P., Talhouarn, F., Kalfas, An., Templelexis, I. (2005) A fully integrated approach to component zooming using computational fluid dynamics, Proceedings of ASME 2005 Turbo & Expo: Power for Land, Sea and Air, June 2005, Reno-Tahoe, Nevada USA.**

## **Περίληψη**

This study focuses on a simulation strategy that will allow the performance characteristics of an isolated gas turbine engine component, resolved from a detailed, high-fidelity analysis, to be transferred to an engine system analysis carried out at a lower level of resolution. This work will enable component-level, complex physical processes to be captured and analyzed in the context of the whole engine performance, at an affordable computing resource and time.

The technique described in this paper utilizes an object-oriented, zero-dimensional (0-D) gas turbine modeling and performance simulation system and a high-fidelity, three-dimensional (3-D) computational fluid dynamics (CFD) component model. The work investigates relative changes in the simulated engine performance after coupling the 3-D CFD component to the 0-D engine analysis system. For the purposes of this preliminary investigation, the high-fidelity component communicates with the lower fidelity cycle via an iterative, semi-manual process for the determination of the correct operating point. This technique has the potential to become fully automated, can be applied to all engine components and does not involve the generation of a component characteristic map.

This paper demonstrates the potentials of the 'fully integrated' approach to component zooming by using a 3-D CFD intake model of a high by-pass ratio (HBR) turbofan as a case study. The CFD model is based on the geometry of the intake of the CFM56-5B2 engine. The high-fidelity model can fully define the characteristic of the intake at several operating condition and is subsequently used in the 0-D cycle analysis to provide a more accurate, physics-based estimate of

intake performance (i.e. pressure recovery) and hence, engine performance, replacing the default, empirical values.

A detailed comparison between the baseline engine performance (empirical pressure recovery) and the engine performance obtained after using the coupled, high-fidelity component is presented in this paper. The analysis carried out by this study, demonstrates relative changes in the simulated engine performance larger than 1%.

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10. Pachidis, V., Pilidis, P., Guindeuil, G., Kalfas, An., Templalexis, I. (2005) *A partially integrated approach to component zooming using computational fluid dynamics*, Proceedings of ASME 2005 Turbo & Expo: Power for Land, Sea and Air, June 2005, Reno-Tahoe, Nevada USA.

### Περίληψη

This study focuses on a simulation strategy that will allow the performance characteristics of an isolated gas turbine engine component, resolved from a detailed, high-fidelity analysis, to be transferred to an engine system analysis carried out at a lower level of resolution. This work will enable component-level, complex physical processes to be captured and analyzed in the context of the whole engine performance, at an affordable computing resource and time.

The technique described in this paper utilizes an object-oriented, zero-dimensional (0-D) gas turbine modeling and performance simulation system and a high-fidelity, three-dimensional (3-D) computational fluid dynamics (CFD) component model. The technique is called 'partially integrated' zooming, in that there is no automatic link between the 0-D engine cycle and the 3-D CFD model. It can be applied to all engine components and involves the generation of a component characteristic map via an iterative execution of the 0-D cycle and the 3-D CFD model. This work investigates relative changes in the simulated engine performance after integrating the CFD-generated component map into the 0-D engine analysis.

This paper attempts to demonstrate the 'partially integrated' approach to component zooming by using a 3-D CFD intake model of a high by-pass ratio (HBR) turbofan as a case study. The CFD model is based on the geometry of the intake of the CFM56-5B2 engine. The CFD-generated performance map can fully define the characteristic of the intake at several operating conditions and is subsequently used to provide a more accurate, physics-based estimate of intake performance (i.e. pressure recovery) and hence, engine performance, replacing the default, empirical values within the 0-D cycle model.

A detailed comparison between the baseline engine performance (empirical pressure recovery) and the engine performance obtained after using the CFD-generated map is presented in this paper. The analysis carried out by this study, demonstrates relative changes in the simulated engine performance larger than 1%.



11. Pachidis, V., Pilidis, P., Templalexis, I., Kotsiopoulos, P. (2007) 2D engine performance simulation using streamline curvature component models, Proceedings of 7<sup>th</sup> European Turbomachinery Conference, Athens, Greece, March 2007.

### Περίληψη

Traditionally gas turbine engine performance has been simulated based on component characteristic maps. These non-dimensional maps assume by default nominal flow conditions throughout the engine and normally do not account for any changes in component geometries, especially when experimental data are not available. Moreover, component characteristic maps, at non-nominal operating conditions, inherently tend to introduce errors due to the extensive averaging of flow properties they involve.

This study utilized a conventional cycle program and two fully integrated two-dimensional streamline curvature component models, namely an intake and a compressor. The high-fidelity components communicated with the low-fidelity cycle analysis at run time, during engine performance simulation, through a fully automated and iterative process. The two-dimensional models were essentially used in the non-dimensional cycle analysis to provide a more flexible, physics-based estimate of intake and compressor performance calculation at operating conditions other than nominal. As a case study, a range of flight Mach numbers and angles of attack were examined together with the effect of three different intake lip geometries on the performance of a notional low-bypass ratio military engine.

The analysis carried out by this study demonstrated relative changes in the predicted engine performance larger than 1%. More importantly, this research effort established the necessary methodology and technology required towards a full, two-dimensional engine cycle analysis at an affordable computational resource in the very short term.

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12. Templalexis, I., Kotsiopoulos, P., Pachidis, V. (2007) Intake-Compressor performance characteristic under inlet flow total pressure distortion, Proceedings of 7<sup>th</sup> European Turbomachinery Conference, Athens, Greece, March 2007.

### Περίληψη

It is widely known that intake inlet total pressure distortion affects greatly the intake and compressor performance parameters. As a result of this, the entire engine performance is also affected. The current paper presents a combined intake-compressor performance simulation tool that produces a performance characteristic map, which reflects the entire operating range of a given compressor

operating behind a given intake, under the influence of a total pressure profile imposed at the intake inlet. Concerning the intake flow simulation a three dimensional (3-D) Vortex Lattice Method (VLM) based Computational Fluid Dynamics (CFD) package is being used. The calculated intake outlet flow conditions are then fed as boundary conditions to a two dimensional (2-D) Streamline Curvature (SLC) method based compressor flow simulation package. The case study presented in this paper concerns a generic subsonic intake mounted in front of a four stage axial flow fan. Such a general case study has been addressed given the lack of relevant experimental data. However, both flow simulation packages have been validated in the past. The generated map can subsequently be used by a zero dimensional (0-D) gas turbine performance analysis tool, for subsequent calculations. The same task can alternatively be performed by a full 3-D Reynolds Averaged Navier-Stokes (RANS) method based engine performance simulation tool, providing results of much increased level of accuracy. However the currently proposed simulation method retains its value, since the required computational resources are reduced by several orders of magnitude.

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13. Pachidis, V., Pilidis, P., Alexander, T., Kalfas, A. and Templalexis, I. (2006) **Advanced performance simulation of a turbofan engine intake**, Transactions of the AIAA, Journal of Propulsion and Power, Vol. 22, No. 1, p. 201.

### Περίληψη

The majority of today's engine simulation software is of a low fidelity (nondimensional). Such tools can offer a good prediction of the performance of a whole engine but are incapable of analyzing the performance of individual engine components in detail, or capturing extreme/complex physical phenomena, that is, inlet flow distortion. On the other hand, computational fluid dynamics (CFD) tools can predict the performance of individual engine components satisfactorily, especially close to design point (DP) operating conditions, but do not offer whole engine performance prediction.

Two issues prevent modeling the entire geometry of a propulsion system at the highest level of resolution (three dimensional) from being a practical solution. First, for a complete three-dimensional system simulation, the amount and level of detailed information needed as boundary and initial conditions would be extremely difficult to obtain. Second, the computational time and cost will be extremely high for effective and practical use.

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14. Pachidis, V., Pilidis, P., Templalexis, I., Barbosa, J. and Nantua, N. (2007) **A De-Coupled Approach To Component High-Fidelity Analysis Using Computational Fluid Dynamics**, Proceedings of the IMechE, Journal of Aerospace Engineering, JAERO37, Vol. 221, Part G, p. 105.

## Περίληψη

This study focuses on a simulation strategy that will allow the performance characteristics of an isolated gas turbine engine component, resolved from a detailed, high-fidelity analysis, to be transferred to an engine system analysis carried out at a lower level of resolution. The technique described in this paper is called 'de-coupled' high-fidelity analysis and utilizes an object-oriented, zero-dimensional gas turbine modelling and performance simulation system and a three-dimensional computational fluid dynamics (CFD) component model. The technique involves the generation of a component characteristic map without the parallel or iterative execution of the non-dimensional cycle and the three-dimensional CFD model. Therefore, a faster high-fidelity engine performance simulation can be achieved at run time. This paper demonstrates the 'de-coupled' approach to component high-fidelity analysis by using a three-dimensional CFD intake model of a high by-pass ratio turbofan as a case study. The CFD model is based on the geometry of the intake of the CFM56-5B2 engine. The CFD-generated performance map can fully define the characteristics of the intake at several operating conditions and power settings, and is subsequently used to provide a more accurate, physics-based estimate of intake performance (i.e. pressure recovery) and hence, engine performance, replacing the default, empirical values within the non-dimensional cycle model. A detailed comparison between the baseline engine performance (empirical pressure recovery) and the engine performance obtained after using the CFD-generated map is presented in this paper. The analysis carried out by this study demonstrates relative changes in the simulated engine performance > 1 per cent.

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15. Pachidis, V., Pilidis, P., Texeira, J., Templalexis, I. (2007) *A Comparison of Component Zooming Simulation Strategies Using Streamline Curvature*, Proceedings of the IMechE, Journal of Aerospace Engineering, JAERO147, Vol. 221, Part G, p. 1.

## Περίληψη

Typically gas turbine engine component characteristics are represented via non-dimensional maps of experimental or default data. In those cases where actual component characteristics are not available and default characteristics are used instead, conventional engine cycle simulation tools can deviate substantially at off-design and transient conditions. Similarly, when real component characteristics are available, conventional tools cannot predict the performance of the engine at other than nominal conditions satisfactorily, or account for the impact of changes in component geometry. Component zooming simulation strategies allow the performance characteristics of an isolated gas turbine engine component, resolved from a detailed, high-fidelity analysis, to be transferred to an engine system analysis carried out at a lower level of resolution. This study looked into the direct comparison of three, well-established zooming strategies utilizing a two-dimensional streamline curvature component model and a low fidelity cycle program. The validated performance of a two-dimensional, low-pressure,

compressor model was integrated with a notional, two-spool, low-bypass ratio, military engine model, according to the 'de-coupled', 'iterative', and 'fully integrated' approaches to high-fidelity analysis. The two-dimensional model was used in the engine cycle analysis to provide a more accurate, physics- and geometry-based estimate of fan performance. Although large differences in the simulated engine performance were not observed as expected, this analysis provided a very valuable insight as to the actual speed of execution, practicality, applicability, and potential of the zooming strategies mentioned above. More importantly, this research effort established the necessary methodology and technology required towards a full, two-dimensional engine cycle analysis at an affordable computational resource in the very short term.

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16. **Templalexis, I., Pilidis, P., Pachidis, V. and Kotsiopoulos, P. (2007) Development of a 2D compressor streamline curvature code, Transactions of the ASME, Journal of Turbomachinery, TURBO-06-1178, Vol. 129, Issue 4, October 2007. ASME Education Committee Best Paper Award for 2006.**

### **Περίληψη**

Two-dimensional compressor flow simulation software has always been a very valuable tool in compressor preliminary design studies, as well as in compressor performance assessment, operating under uniform and non-uniform inlet conditions. In this context, a new streamline curvature (SLC) software has been developed capable of analyzing the flow inside a compressor in two dimensions. The software was developed to provide great flexibility, in the sense that it can be used as: a) A performance prediction tool for compressors of a known design, b) A development tool to assess the changes in performance of a known compressor after implementing small geometry changes, c) A design tool to verify and refine the outcome of a preliminary compressor design analysis, d) A teaching tool to provide the student with an insight of the two-dimensional flow field inside a compressor and how this could be effectively predicted using the SLC method, combined with various algorithms and loss models, e) A 2-D compressor model that can be integrated into a conventional 0-D gas turbine engine cycle simulation code for the investigation of the influence of non-uniform radial pressure profiles on whole engine performance. Apart from describing in detail the design, structure and execution of the SLC software, this paper also stresses the importance of developing robust, well thought-out software and highlights the main areas a potential programmer should focus on in order to achieve this. This manuscript highlights briefly the programming features incorporated into the development of software before continuing to explain the internal workings of individual algorithms. The paper reviews in detail the set of equations used for the prediction of the meridional flow field. Numerical aspects of the application procedure of the full radial equilibrium equation are examined. The loss models incorporated for subsonic and supersonic flow are presented for design and off design operating conditions. Deviation angle rules are presented, together with the parameters for

quantifying the diffusion process. Moreover, the methods used for the prediction of surge and choke are discussed in detail. Finally, the end wall boundary layer displacement thickness calculation is discussed briefly, in conjunction with the blockage factor computation. The code has been validated against experimental results which are presented in this paper together with the strong and weak points of this first version of the software and the potential for future development.

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17. Pachidis, V., Pilidis, P., Marinai, L., Templalexis, I. (2007) **Towards a full two dimensional gas turbine performance simulation**, Proceedings of the Royal Aeronautical Society, The Aeronautical Journal, AJ-3127, June 2007.

### **Περίληψη**

In commercially available gas turbine performance simulation tools, individual engine components are typically represented with non-dimensional maps of experimental or default data. In those cases where actual component characteristics are not available and default characteristics are used instead, conventional tools can deviate substantially at off-design and transient conditions. Similarly, when real component characteristics are available, conventional engine cycle simulation tools can not predict the performance of the engine at other than nominal conditions satisfactorily, or account for the impact of changes in component geometry. This study looked into the full integration of two-dimensional streamline curvature component models with a low fidelity cycle program. Firstly, the obtained engine performance was compared against the one calculated based on default component characteristics. As a second case study, a range of flight Mach numbers and angles of attack were examined together with the effect of three different intake lip geometries on the performance of a notional, two-spool, low-bypass ratio, military engine. Two-dimensional models were used in the engine cycle analysis to provide a more accurate, physics- and geometry-based estimate of intake and fan performances. The analysis carried out by this study demonstrated relative changes in the predicted engine performance larger than 1%. For brevity, representative results are presented and discussed in this paper for one flight Mach number and angle of attack setting. More importantly, this research effort established the necessary methodology and technology required towards a full, two-dimensional engine cycle analysis at an affordable computational resource in the very short term.

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18. Papagiannakis, G.R., Hountalas, T.D., Rakopoulos, D.C. (2006) **Theoretical study of the effects of pilot fuel quantity and its injection timing on the performance and the emissions of a dual fuel diesel engine**, Proceedings of the ECOS 2006, Vol. 2.

## Περίληψη

Various solutions have been proposed for improving the combustion process of conventional diesel engines and reducing the exhaust emissions without making serious modifications on the engine, one of which is the use of natural gas as a supplement for the conventional diesel fuel, the so called dual fuel natural gas diesel engines. The most common type of these is referred to as the pilot ignited natural gas diesel engine (PINGDE). Here, the primary fuel is natural gas that controls the engine power output, while the pilot diesel fuel injected near the end of the compression stroke auto-ignites and creates ignition sources for the surrounding gaseous fuel mixture to be burned. Previous research studies have shown that the main disadvantage of this dual fuel combustion is its negative impact on engine efficiency compared to the normal diesel operation, while carbon monoxide emissions are also increased. The pilot diesel fuel quantity and injection advance influence significantly the combustion mechanism. Then, in order to examine the effect of these two parameters on the performance and emissions, a comprehensive two-zone phenomenological model is employed and applied on a high-speed, pilot ignited, natural gas diesel engine located at the authors' laboratory. According to the results, the simultaneously increase of the pilot fuel quantity accompanied with an increase of its injection timing results to an improvement of the engine efficiency (increase) and of the emitted CO emissions (decrease) while it has a negative effect (increase) of NO emissions.

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19. Hountalas, T.D., Papagiannakis, G.R., Kotsiopoulos, P.N. (2005) **Experimental and Theoretical Analysis of the Combustion and Pollutants Formation Mechanisms in Dual Fuel DI Diesel Engines**, Proc. SAE 2005 World Congress, Vol. SP CI Engine Performance for Use with Alternative Fuels and New Diesel Engine and Components.

## Περίληψη

With the increasing public interest in energy supply and the environment, attention has focused on the development of ecological and efficient combustion technologies. One of these technologies could be the use of natural gas as supplement fuel for diesel fuel in DI diesel engines. The great availability at attractive prices and the clean nature of combustion are the most important advantages of natural gas compared to conventional diesel fuel. In the present work are given theoretical and experimental results for the combustion mechanism of natural gas in a compression ignition environment, with special emphasis on the combined heat release rate of natural gas and diesel fuel, the duration of combustion and the ignition delay period. Results are also provided for the formation history of pollutants inside the combustion chamber of a DI diesel engine operating in dual-fuel mode (with natural gas fuelling). The model used is a two-zone phenomenological one describing the combustion mechanisms of natural gas and diesel fuel. Natural gas is ignited from the diesel fuel and the existence of a flame front is considered to describe its combustion rate. The experimental investigation was conducted on a single-cylinder DI diesel engine properly modified to operate under dual-fuel conditions using natural gas as supplementary

fuel. The experimental results seem to be in good agreement with the theoretical ones, obtained from the simulation model. Comparing the results under normal diesel and dual-fuel operation a serious effect of the presence of natural gas on exhaust emissions and main combustion characteristics is observed. As far as the exhaust emissions are concerned, the presence of gaseous fuel affects positively (reduction) the values of NO and Soot. On the contrary dual-fuel operation has a negative effect on CO emissions. Concerning the combustion analysis of dual-fuel operation, heat release rate is affected seriously by the presence of natural gas in the combustion chamber. Compared to normal diesel operation, the increase of natural gas quantity results to a decrease of the percentage of heat released during premixed combustion period while ignition delay increases. Combustion duration is higher under dual-fuel operation at low load, but with the increase of load the difference is decreased and it becomes even lower compared to normal diesel operation at high load.

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20. Kotsiopoulos, P.N., Papagiannakis, G.R., Tsakalou, P., Gazinou, I., Yfantis, E. (2007) Experimental Investigation Concerning the Effect of the Use of Biodiesel and F-34 (JP-8) Aviation Fuel on Performance and Emissions of a DI Diesel Engine, Proc. SAE 2007 World Congress, Vol. SP Military Vehicles.

### Περίληψη

Single Fuel Policy arose as a necessity in order to fulfill an effectiveness of the used equipment through the use of a single fuel in the battlefield. Thus, it was first ensured that the fuel's specification was standard with the equivalent commercial fuel which is still in use in the NATO countries and of course that the fuel's chemical characteristics allow it to be imported, stored, carried and distributed through the NATO oil piping system. So, in 1998 the NATO countries agreed to adopt the use of F-34 as a single fuel. Furthermore, the atmospheric pollution, which is one of the greatest problems that concerns especially the vehicle industries, drove the research on fuels to bio-fuels, like bio-diesel. Bio-diesel is an alternative fuel, which can be used by a diesel engine, even a military one, without a beforehand modification. It is produced by natural, renewable sources, like vegetable oil and animal fat. International bibliography includes a great amount of information concerning the effect of the use of bio-diesel on performance and pollutant emissions (Oxides of Nitrogen, Carbon Monoxide, unburnt Hydrocarbons and Soot) of a Direct Injection (DI) diesel engine. In this respect, an experimental investigation has been conducted in the laboratory of Thermodynamic and Propulsion Systems at the Hellenic Air Force Academy. The main scope of the present investigation is to evaluate the use of F-34 and bio-diesel as a full substitute for diesel fuel in a direct injection diesel engine. Thus, the present work covers a range of engine load and speed operating conditions under bio-diesel, F-34 and normal diesel operation (baseline conditions), comprising measurements of engine power output, fuel consumption, exhaust gas temperature and the concentrations of exhaust gas emissions (Nitrogen Oxide and Soot). Through this

work it is shown that for all test cases examined when diesel fuel is full substituted by F-34 no significant effect is observed on the basic operating parameters and the brake specific fuel consumption as well while it seems to affect the maximum combustion pressure and the ignition delay period. As far as the exhaust emissions are concerned, the full substitution of diesel fuel with F-34 has a negligible influence on the concentrations of Nitrogen Oxide emissions while it seems to affect seriously the values soot emission concentrations. As far as the behavior of bio-diesel compared with diesel is concerned, the results revealed a slight increase in the exhaust gas temperature, an increase in the brake specific fuel consumption, which at low loads tends to be identified with the diesel, a decrease in soot emissions and brake thermal efficiency, and finally a slight decrease in NO emissions at low loads, while at full load NO emissions are considerable higher.

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21. Papagiannakis, G.R., Kotsiopoulos, P.N., Hountalas, T.D., Yfantis, E. (2006) *Single Fuel Research Program Comparative Results of the Use of JP-8 Aviation Fuel versus Diesel Fuel on a Direct Injection and Indirect Injection Diesel Engine*, Proc. SAE 2006 World Congress, Vol. SP Military Vehicles.

### Περίληψη

During the last years a great effort has been made by many NATO nations to move towards the use of one military fuel for all the land-based military aircraft, vehicles and equipment employed on the military arena. This idea is known to as the Single Fuel Concept (SFC). The fuel selected for the idea of SFC is the JP-8 (F-34) military aviation fuel which is based upon the civil jet fuel F-35 (Jet A-1) with the inclusion of military additives possessing anti-icing and lubricating properties. An extended experimental investigation has been conducted in the laboratory of Thermodynamic and Propulsion Systems at the Hellenic Air Force Academy. This investigation was conducted with the collaboration of the respective laboratories of National Technical University of Athens and Hellenic Naval Academy as well. The main scope of this investigation is to evaluate the use of JP-8 aviation fuel as a full substitute for Diesel Fuel in various types of diesel engines, namely Direct and Indirect Injection Diesel Engines respectively. The present contribution is a review work concerning experimental data for performance and exhaust emissions coming from the operation of the two types of diesel engines with JP-8 fuel. Specifically, the present work covers a range of engine load and speed operating conditions under JP-8 and normal diesel operation (baseline conditions), comprising measurements of cylinder pressure and Injection pressure diagrams, fuel consumption and the concentrations of exhaust gas emissions (Nitrogen Oxide (NO), Carbon Monoxide (CO), Unburnt Hydrocarbons (HC) and Soot) for both types of engines. The differences in the measured performance and exhaust emissions data are determined for the JP-8 fuel engine operation against the normal diesel operation. According to the results presented in this work, for both types of engines (DI and IDI) examined it is revealed a significant effect of JP-8



fuel combustion on some basic engine operating parameters (maximum combustion pressure, ignition delay period, etc.) compared to standard diesel operation. As far as the exhaust emissions are concerned, the full substitution of diesel fuel with JP-8 affects positively (reduction) the values of the Carbon Monoxide concentrations while it seems to have a negligible influence on the concentrations of Nitrogen Oxide emissions for both types of engines. On the other hand the operation of each type of engine with JP-8 fuel seems to affect seriously the values of the unburnt hydrocarbons and soot emission concentrations compared to the respective values observed under normal diesel operation.

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22. Papagiannakis, G.R., Hountalas, T.D. (2003) **Combustion and exhaust emission characteristics of a dual fuel compression ignition engine operated with pilot Diesel fuel and natural gas**, Energy Conversion and Management, Volume 45, Issues 18-19, November 2004, Pages 2971-2987.

#### **Περίληψη**

Towards the effort of reducing pollutant emissions, especially soot and nitrogen oxides, from direct injection Diesel engines, engineers have proposed various solutions, one of which is the use of a gaseous fuel as a partial supplement for liquid Diesel fuel. These engines are known as dual fuel combustion engines, i.e. they use conventional Diesel fuel and a gaseous fuel as well. This technology is currently reintroduced, associated with efforts to overcome various difficulties of HCCI engines, using various fuels. The use of natural gas as an alternative fuel is a promising solution. The potential benefits of using natural gas in Diesel engines are both economical and environmental. The high autoignition temperature of natural gas is a serious advantage since the compression ratio of conventional Diesel engines can be maintained. The present contribution describes an experimental investigation conducted on a single cylinder DI Diesel engine, which has been properly modified to operate under dual fuel conditions. The primary amount of fuel is the gaseous one, which is ignited by a pilot Diesel liquid injection. Comparative results are given for various engine speeds and loads for conventional Diesel and dual fuel operation, revealing the effect of dual fuel combustion on engine performance and exhaust emissions.

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23. Zannis, C.T., Hountalas, T.D., Papagiannakis, G.R. (2007) **Experimental study of diesel fuel effects on direct injection (DI) diesel engine performance and pollutant emissions**, Energy & fuels, vol. 21, 5, pp. 2642-2654.

## Περίληψη

An experimental investigation was conducted to specify the effect of diesel fuel composition and its physical and chemical properties on direct injection (DI) diesel engine performance characteristics and pollutant emissions. Engine tests were made on a single-cylinder naturally aspirated DI diesel engine (Lister LV1), which is located at the laboratory of the authors, at various operating conditions using seven conventional diesel fuels. The test fuels indicate variable hydrocarbon composition and physical and chemical properties, and they were prepared under a European Union research program aiming to identify future fuel formulations for use in modern DI diesel engines. Emphasis was given to the examination of the effect of diesel fuel density, viscosity, and compressibility factor on the fuel injection system, engine combustion characteristics, and diesel-emitted pollutants. Having observed that many diesel fuel parameters are strongly interrelated, we carried out a multivariable statistical analysis to determine the fuel property pairs that are statistically independent. Using experimental findings for pollutant emissions and independent fuel property pairs, a linear multiple regression analysis was conducted to identify potential correlations between diesel-emitted pollutant emissions and the fuel parameters. The sensitivity analysis revealed that soot emissions depend upon fuel viscosity, cetane number, and fuel volatility, whereas NO, CO, and HC emissions mainly depend upon fuel aromatic content. The evaluation of experimental results showed that reductions of soot, NO, and CO emissions can be attained with the reduction of the distillation temperature and the increase of paraffinics/naphthenics ratio, which mainly provide the reduction of fuel viscosity and, secondarily, the decrease of the density and increase of the compressibility factor.

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24. **Rakopoulos, C.D., Rakopoulos, D.C., Giakoumis, G.E., Papagiannakis, G.R., Kyritsis, C.D. (2007) Experimental-stochastic investigation of the combustion cyclic variability in HSDI diesel engine using ethanol–diesel fuel blends, Fuel, Volume 87, Issues 8-9, July 2008, Pages 1478-1491.**

## Περίληψη

An experimental investigation is conducted to evaluate the combustion characteristics of a fully instrumented, high-speed, direct injection (HSDI), standard 'Hydra' diesel engine, at various loads when using ethanol–diesel fuel blends up to 15% by vol. ethanol. In each test, combustion chamber and fuel injection pressure diagrams of many consecutive cycles were obtained using a specially developed, high-speed, data acquisition and processing system. Following a performance and exhaust emissions investigation and a heat release analysis of the measured cylinder pressure diagrams reported by the authors, the present work focuses on the cycle-by-cycle combustion variation (cyclic variability) as reflected in the pressure indicator diagrams, by analyzing for the maximum pressure, maximum pressure rate, (gross) indicated mean effective pressure, and dynamic injection

timing and ignition delay. These parameters were analyzed using stochastic analysis techniques for averages, standard deviations, coefficients of variation, probability density functions, auto-correlations, power spectra and cross-correlation coefficients. Thus, any cause and effect relationship between cyclic pressure variations and the injection system or the kind of fuel used can be revealed, given the concern for the low cetane number of ethanol blends promoting cyclic variability that can lead to degraded performance and emissions characteristics.

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25. Papagiannakis, G.R., Hountalas, T.D., Rakopoulos, D.C. (2007) Theoretical study of the effects of pilot fuel quantity and its injection timing on the performance and emissions of a dual fuel diesel engine, Energy Conversion and Management, Volume 48, Issue 11, Pages 2951-2961

#### Περίληψη

Various solutions have been proposed for improving the combustion process of conventional diesel engines and reducing the exhaust emissions without making serious modifications on the engine, one of which is the use of natural gas as a supplement for the conventional diesel fuel, the so called dual fuel natural gas diesel engines. The most common type of these is referred to as the pilot ignited natural gas diesel engine (PINGDE). Here, the primary fuel is natural gas that controls the engine power output, while the pilot diesel fuel injected near the end of the compression stroke auto-ignites and creates ignition sources for the surrounding gaseous fuel mixture to be burned. Previous research studies have shown that the main disadvantage of this dual fuel combustion is its negative impact on engine efficiency compared to the normal diesel operation, while carbon monoxide emissions are also increased. The pilot diesel fuel quantity and injection advance influence significantly the combustion mechanism. Then, in order to examine the effect of these two parameters on the performance and emissions, a comprehensive two-zone phenomenological model is employed and applied on a high-speed, pilot ignited, natural gas diesel engine located at the authors' laboratory. According to the results, the simultaneously increase of the pilot fuel quantity accompanied with an increase of its injection timing results to an improvement of the engine efficiency (increase) and of the emitted CO emissions (decrease) while it has a negative effect (increase) of NO emissions.

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26. Χουντάλας, Θ.Δ., Παπαγιαννάκης, Γ.Ρ. (2005) Δυνατότητα Χρήσης Φυσικού Αερίου σε Υπάρχοντες Κινητήρες Ντίζελ, Τεχνικά Χρονικά, Ιανουάριος-Φεβρουάριος 2005.

## Περίληψη

Η ρύπανση της ατμόσφαιρας και ο συνεχώς αυξανόμενος ρυθμός μείωσης των αποθεμάτων ενεργειακών πρώτων υλών αποτελούν τα πιο οξυμένα προβλήματα, τα οποία καλείται να αντιμετωπίσει ο σύγχρονος άνθρωπος. Όπως κάθε θερμική μηχανή έτσι και ο κινητήρας Ντίζελ συμβάλλει στην ύπαρξη των ανωτέρω προβλημάτων. Στην προσπάθεια μείωσης της ανωτέρω αρνητικής συμβολής του κινητήρα Ντίζελ, διεξάγονται έρευνες, οι οποίες δίνουν έμφαση σε διάφορα πεδία, ένα από τα οποία είναι και η χρήση της Μεικτής Καύσης. Η παρούσα εργασία έχει σκοπό να παρουσιάσει την επίδραση που έχει η μεικτή καύση καυσίμου Ντίζελ και Φυσικού Αερίου στη συμπεριφορά υπάρχοντα κινητήρα Ντίζελ, ο οποίος έχει κατάλληλα τροποποιηθεί για αυτό το σκοπό. Με τη διενέργεια πειραματικών μετρήσεων επί του συγκεκριμένου κινητήρα τόσο υπό συνθήκες κλασσικής λειτουργίας όσο και υπό συνθήκες μεικτής καύσης εκτιμήθηκε ότι η υπό εξέταση μέθοδος επηρεάζει θετικά τη συμπεριφορά του κινητήρα όσον αφορά στις εκπομπές NOx και αιθάλης. Ταυτόχρονα, όμως, επιδρά αρνητικά στην ειδική κατανάλωση καυσίμου, στις εκπομπές μονοξειδίου του άνθρακα και υδρογονανθράκων, ιδιαίτερα στα χαμηλά φορτία λειτουργίας.

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27. Papagiannakis, G.R., Hountalas, T.D. (2003) *Experimental investigation concerning the effect of natural gas percentage on performance and emissions of a DI dual fuel diesel engine*, Applied Thermal Engineering, Volume 23, Issue 3, Pages 353-365.

## Περίληψη

During the last years a great effort has been made to reduce pollutant emissions from direct injection (DI) diesel engines. Towards this, engineers have proposed various solutions, one of which is the use of gaseous fuels as a supplement for liquid diesel fuel. These engines, which use conventional diesel fuel and gaseous fuel, are referred to as dual fuel engines. The main aspiration from the usage of dual fuel (liquid and gaseous one) combustion systems is mainly to reduce particulate emissions and nitrogen oxides. One of the gaseous fuels used is natural gas, which has a relatively high auto ignition temperature and moreover is an economical and clean burning fuel. The high auto ignition temperature of natural gas is a serious advantage against other gaseous fuels since the compression ratio of most conventional DI diesel engines can be maintained. Moreover the combustion of natural gas produces practically no particulates since natural gas contains less dissolved impurities (e.g. sulfur compounds). The present contribution is mainly concerned, with an experimental investigation of the characteristics of dual fuel operation when liquid diesel is partially replaced with natural gas under ambient intake temperature in a DI diesel engine. Results are given revealing the effect of liquid fuel percentage replacement by natural gas on engine performance and emissions.

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28. Kotsiopoulos, N.P. (2007) **Proposals for Solutions to Problems Related to the Use of F-34 (SFP) and High-Sulfur Diesel on Ground Equipment Using Advanced Emission Reduction Technologies**, NATO/RTO AVT 073, Final Report, Florence, Italy.

#### Περίληψη

The ET-073 needed to consider current technologies, adapting these to best meet military requirements. As a consequence of this, nations such as Germany conducted work in close relationship with the industry to identify possible solutions. The ET-073 team agreed following programme of work addressing the short term and long term strategies:

- Considering the need for a quick answer to the NATO Pipeline Committee (NPC), it was decided to provide a guidance and advice document based on current technologies to procurement services.
- To address the long term impact of the use of the HSF, it was decided that more work was needed and that this would be best addressed in the new Task Group AVT-159 investigating of “Impact of Changing Fuel upon Land, Air and Sea Vehicles”.

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29. Lois, E., Kotsiopoulos, P. (2003) **European Fuel Specifications and Engine Emissions Regulations: a Review**, NATO/RTO AVT Panel Single Fuel Concept Workshop, Warsaw, Poland, Oct 7-9.

#### Περίληψη

In response to the growing scientific evidence and increasing public concern about the adverse effects of air pollution, the local authorities have put pressure on vehicle manufacturers for the development of new, more efficient exhaust emissions control systems, and on refiners for the production of new “cleaner” motor fuels. The present paper presents the most recent specifications of gasoline and diesel fuels, examined from the viewpoint of engine performance and emissions. The latest emission standards in European Union are also presented.

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30. Korres, M.D., Karonis, D., Lois, E., Kotsiopoulos, P., (2003) **Use of Alternative Fuels on a Diesel Engine**, NATO-RTO AVT Panel Single Fuel Concept Workshop, Warsaw, Poland, Oct 7-9.

## Περίληψη

The Single Fuel Concept refers to the NATO initiative towards the use of a single fuel for all land based military aircraft, vehicles and equipment when employed on the European battlefield. The single fuel selected was F-34 (JP-8), which is based upon the civil jet fuel F-35 (Jet A-1), with the inclusion of a military additive possessing anti-icing properties. However, environmental pollution problems were identified in the process of implementing the SFC. The necessity to cope with these and the strict requirements of modern Diesel engines lead to the need to improve the SFC quality. The development of biomass derived substitutes for Diesel fuel is a possible attractive outlet, as it could help improve the quality. The present paper aims to contribute to the evaluation of biodiesel and other types of fuels as possible substitutes of diesel. The fuels used were a typical Greek automotive diesel (EN-590), an ultra low sulfur diesel, a high cetane number diesel fuel, JP-8 and two types of biodiesel, alone or in mixtures with the above fuels. The fuels and the mixtures were analysed for their physicochemical properties in the Laboratory of Fuels Technology and Lubricants of NTUA and the engine tests were conducted on a single cylinder stationary diesel engine.

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31. Korres, M.D., Lois, E., Kotsiopoulos, P., Karonis, D. (2003) **Quality Aspects of Jet Fuel of the Greek Market**, NATO-RTO AVT Panel Single Fuel Concept Workshop, Warsaw, Poland, Oct 7-9.

## Περίληψη

The goal of the present paper is to discuss the quality characteristics of Jet Fuels used in the Greek market in comparison with fuels used in other countries. In general, Jet Fuels produced in Greece satisfy the specifications set for each type of fuel by the appropriate authorities. For each property, graphs are presented which show the property's fluctuation over time and the respective average values of U.S. and British Fuels over the years. These graphs show that Greek Jet Fuels have much higher sulfur content than the fuels used in the U.S.A. or Britain, but also have a higher cetane index. The values of most of the other properties lie between the respective values for British or U.S. fuels. A significant quality parameter for Jet Fuels is contamination by heavier fuels. For this reason, a novel method for the determination of jet fuel and gasoline contamination is presented, which is under development by the Laboratory of Fuels Technology and Lubricants, NTUA. The results produced by this method are compared to those produced by the ASTM D-86 method.

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32. Kotsiopoulos, P., Papagiannakis, R., Yfantis, El., Hountalas, D., Korres, M.D. (2003) **The Single Fuel Concept (JP - 8 / F - 34) Research and Field Experience In Greece**, NATO-RTO AVT Panel Single Fuel Concept Workshop, Warsaw, Poland, Oct 7-9.

## **Περίληψη**

The scope of the present work is to report experimental results from an extensive investigation concerning the evaluation of the use of JP-8/F-34 aviation fuel as a full substitute for diesel fuel in various direct and indirect injection four-stroke diesel engines. The Greek experience from the use of JP-8/F-34 on various types of army vehicles (Battle Tanks, Fork Trucks, etc) is also reported. Details are given about the influence of JP-8/F-34 on engine performance and exhaust emissions of various diesel engines and about field tests which were conducted using JP-8/F-34 fuel in various diesel engine vehicles of the hellenic army forces and the results of the trials in connection with the effect of JP-8/F-34 on the quality of the engine operation.



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