

CHRISTOS NICOLAOS MARKIDES

Date of Birth: 6th of March, 1978 Address: Hopkinson Laboratory, Department of Engineering,
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RESEARCH AND TEACHING EXPERIENCE

2006 – Thermofluidics Ltd. and University of Cambridge, Department of Engineering, Cambridge, U.K.

Present: **Co-founder and Director of Research and Development (R&D) Spin-Off Start-up Company and Embedded Researcher in Experimental Thermofluidics and Heat Transfer**

Having been involved in parallel with a project investigating thermofluidic oscillator engines (fluid systems in which oscillations are driven by heat flows as a consequence of heat transfer alone) I accepted a proposal by Dr. Thomas C.B. Smith to form an entrepreneurial partnership to further the research and development of these novel heat engines. Thermofluidics is a recent spin-off of the Cambridge University Engineering Department, where we have set-up a laboratory. We are currently working on a class of thermofluidic oscillators known as ‘Non-Inertive-Feedback Thermofluidic Engines’ (NIFTE) that do not depend on inertia to sustain oscillations. This patented technology has recently won the prestigious Royal Institution Graduate Student and Sunday Times One Minute Pitch competitions from which funding of more than £100,000 has been made available. NIFTE is rather like an analogue electronic oscillator, in which inductance is provided by inertia, capacitance is provided by compressibility, hydrostatic pressure changes and thermal capacity, resistance is provided by viscosity, imperfect heat transfer and ideally, work done on a useful load, and amplification is provided by temperature differences. This means that it can sustain greater pressure amplitudes than its predecessors and can be applied to thermally powered pumping and heat pumping applications on a wider range of scales, using a variety of heat sources. NIFTE can provide a cost effective solution to many heat and fluid transfer problems, particularly to improve energy efficiency and to provide pumping power when heat is readily available while other energy sources (e.g. electricity) are scarce. It also has many humanitarian applications, such as the supply of drinking water or water for agriculture in developing and third-world countries.

2006 – Robinson College, Cambridge, U.K.

Present: **Official Teaching Fellow and Director of Studies of Robinson College in Engineering**

After a competitive selection process and interviews with the college governing body, I was offered an official fellowship by Robinson College. I am a Director of Studies for first year undergraduate Engineering students and teach the first and second year students in the subjects of Thermofluids, Heat and Mass Transfer and Mathematics for approximately 6 hours per week.

2005 – University of Cambridge, Department of Engineering, Cambridge, U.K.

2006: **Research Associate Post-doctoral Position in Turbulent Mixing and Autoignition**

A proposal for the funding of a 3-year post-doctoral project was accepted by the U.K. government organization ‘Engineering and Physical Sciences Research Council’ (EPSRC) involving the continuation of and based on my Ph.D. work, in collaboration with Dr. Epaminondas Mastorakos and Prof. Simone Hochgreb. This project involved detailed measurements of pre-ignition chemistry with Planar Laser Induced Fluorescence of formaldehyde, autoignition at high pressures and the autoignition of evaporating droplets. Emphasis was placed on numerical predictions, particularly simulations with Conditional Moment Closure (CMC).

2001 – University of Cambridge, Department of Engineering, Cambridge, U.K.

Present: **Teaching and Open day Experiment Demonstrator**

I have demonstrated experiments in a wide variety of subjects including coursework on Data Transmission, Spectrum Analysis, Flame Propagation, Inviscid Fluid Flow and a number of experiments in the Aerodynamics Laboratory Wind Tunnels. The Flame Propagation experiment demonstrated during 2003 – 2004 achieved top marks in that year’s Departmental Undergraduate Student Survey.

2001 – University of Cambridge, Department of Engineering, Cambridge, U.K.

2003: **Clare College and New Hall College Supervisor in Mathematics and Thermofluids**

After being recommended by the Head of my Laboratory, the Directors of Studies for the Natural Sciences and Engineering courses requested me to teach first and second year undergraduate students in two colleges.

2001 – Foundation for Research and Technology (FORTH) and

2003: Institute of Chemical Engineering and High Temperature Processes (ICE-HT), Patras, Greece

Doctoral Research Associate in EU Project ‘Simulation Tools for Pollutant Predictions’ (STOPP)

This project addressed the topical problem of modelling turbulent reactive flow scenarios, such as autoignition or atmospheric pollution, in which scalar dispersion (turbulent mixing) and chemical processes are equally important. I carried out research into chemistry reduction mechanisms, and the introduction and development of Conditional Moment Closure (CMC) modelling methods to further the work carried out for my Ph.D. I was responsible for the development of the CMC codes that have subsequently been used for the successful prediction of autoignition that has been observed and measured in the experiments of my Ph.D.

1997: Completed the twenty six months of compulsory military service in Cyprus.

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ACADEMIC QUALIFICATIONS

2001 – University of Cambridge, Department of Engineering and
2005: Clare College, Cambridge, U.K.

Doctor of Philosophy Degree in Energy, Fluid Mechanics and Turbomachinery

Thesis title: 'Autoignition in Turbulent Flows'

Examiners: Prof. William Jones, Dr. Steward Cant

Supervisor, Advisor: Dr. Epaminondas Mastorakos, Dr. Robert Miller

In order to improve the new generation of combustors used in modern engines and gas turbines, making them safer and more environmentally friendly, it has become increasingly important to predict and control the dominant phenomenon of autoignition. In these applications autoignition occurs in the presence of intense velocity and concentration fluctuations that cannot be ignored and whose effect on the slow autoignition chemistry must be understood. The aims of this project were to improve our fundamental understanding of the underlying physical processes of autoignition, with particular attention to the effects of turbulent mixing, through a mostly experimental, multi-disciplinary approach involving Chemistry, Thermodynamics, Fluid Mechanics and Heat and Mass Transfer. The most important results from this work have been to completely clarify the effect of turbulent mixing on autoignition chemistry and to experimentally verify the existing theory regarding autoignition in a turbulent, non-premixed flow. It involved amongst other hot wire, fine thermocouple, gas and spectral analyzer and Photo-Multiplier Tube measurements, chemiluminescence and thermal/infrared imaging, Planar Laser Induced Fluorescence (PLIF) of the hydroxyl radical (OH) and acetone, Mie scattering with a high-speed copper vapour laser and the complete development of a high-speed ultraviolet imaging system consisting of a two-stage intensified Complimentary Metal Oxide Semiconductor (CMOS) camera and a new high temperature process heater for which a patent will be claimed.

In collaboration and funded by Ford and EPSRC.

2000 – University of Cambridge, Department of Engineering and
2001: Clare College, Cambridge, U.K.

Masters of Engineering Degree in Fluid Mechanics and Thermodynamics

Obtained Honours with Distinction out of fourteen Distinctions given to fourth year engineering students and four Distinctions given to fourth year students specializing in Fluid Mechanics and Thermodynamics. In addition, four papers were taken in Electrical and Information/Mathematics.

Studied Modules: Aircraft Stability and Control, Aerodynamics, Flow Instability, Turbulence, Control System Design, Robust Multivariable and Optimal Control, Non-linear and Adaptive Control, and, Linear Algebra and Optimisation.

Project: World Water Speed Record. Experimental optimization of the performance of a complex geometry watercraft, through design and testing, in order to make its aerodynamic characteristics controllable at high speeds.

1997 – University of Cambridge, Department of Engineering and
2000: Clare College, Cambridge, U.K.

Bachelor of Arts Degree in Engineering

Obtained Class I (Excellent) with Honours and was ranked 5th out of 121 third year Engineering students.

Studied Papers: Environmental Engineering, Fluid Mechanics I, Fluid Mechanics II, Energy and Power Generation, and, Control and Signal Processing.

Projects: Airfoil Design and Digital Robot Control.

1994 – Private tuition lessons and self-teaching/preparation, Limassol, Cyprus

Advanced-Level Examinations

Was awarded two Medallions by the University of London for Excellence in the 1995 Chemistry and Applied Mathematics A-Level examinations. Achieved 5 As in Physics, Mathematics, Further Mathematics, Chemistry and Statistics examinations with no retakes.

1992 – Lanition Lyceum B', Limassol, Cyprus

Lyceum Apolitirion (High School Degree)

Awarded Excellence Diploma for three consecutive years. End-of-year results: 1993 - 1992 (19.8/20.0), 1994 - 1993 (19.3/20.0), and, 1995 - 1994 (19.2/20.0). Overall result: 19.6 out of 20.0 (98%).

1990 – Private tuition lessons and self-teaching/preparation, Limassol, Cyprus

Ordinary-Level and Advanced-Ordinary-Level Examinations

Language results: Modern Greek (A), English Language (B). Achieved 4 As in 4 science examinations.

1989 – Theklion Gymnasium, Limassol, Cyprus

Gymnasium Apolitirion (Secondary School Degree)

Awarded Excellence Diploma for three consecutive years. All As and 1 B grade.

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PROFESSIONAL MEMBERSHIPS

1. 'The Royal Aeronautical Society' (RAeS)
 2. 'The Combustion Institute'
 3. 'American Society of Mechanical Engineers' (ASME)
 4. 'American Institute of Aeronautics and Astronautics' (AIAA)
 5. 'Institute of Physics' (IOP)
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LIST OF PUBLICATIONS

Journal:

1. "An Experimental Study of Hydrogen Autoignition in a Turbulent Co-Flow of Heated Air", **C.N. Markides** & E. Mastorakos, *Proceedings of the Combustion Institute*, **30**, 2005, 883-891. **John Winbolt Prize**.
2. "Measurements of Scalar Dissipation in a Turbulent Plume with Planar Laser-Induced Fluorescence of Acetone", **C.N. Markides** & E. Mastorakos, *Chemical Engineering Science*, **61**, 2006, 2835-2842.
3. "Measurements and Simulations of Mixing and Autoignition of an n-Heptane Plume in a Turbulent Flow of Heated Air", **C.N. Markides**, G. De Paola & E. Mastorakos, *Experimental Thermal and Fluid Science*, 2006, in press.
4. "Flame Propagation Following the Autoignition of Axisymmetric Hydrogen, Acetylene and Normal-Heptane Plumes in Turbulent Co-flows of Hot Air", **C.N. Markides** & E. Mastorakos, *ASME Journal of Engineering for Gas Turbines and Power*, 2006, in press.
5. "Characteristics of Autoignition Sites in Turbulent Non-Premixed Flows", **C.N. Markides** & E. Mastorakos, *Combustion and Flame*, 2006, in peer review.
6. "Experiments of Autoignition in Turbulent Axisymmetric Inhomogeneous Co-flows", **C.N. Markides** & E. Mastorakos, *Combustion and Flame*, in peer review.
7. "On the Influence of Turbulent Mixing on the Location of Autoignition in Turbulent Flows", **C.N. Markides** & E. Mastorakos, *Combustion and Flame*, in preparation.
8. "Experimental and Numerical Investigation of the Conditional Scalar Dissipation Rate", C.N. Markides, N. Chakraborty & E. Mastorakos, *Physics of Fluids*, in preparation.
9. "Experiments and Modelling of Scalar Mixing in Turbulent Non-Premixed Flows", **C.N. Markides**, S.F.A.F.S. Ahmed, R. Balachandran, I.S. Kim, C.B. Devaud & E. Mastorakos, *Physics of Fluids*, in preparation.
10. "Simultaneous Measurements of Concentration and Temperature with Two-Line Planar Laser-Induced Fluorescence of Acetone", *Experiments in Fluids*, **C.N. Markides**, R. Balachandran & E. Mastorakos, in preparation.

Conferences:

1. "Hydrogen Autoignition in a Turbulent Duct Flow: Experiments and Modelling", E. Mastorakos, **C.N. Markides** & Y.M. Wright, *EM2C & CNRS 12th International Conference on Fluid Flow Technologies*, Budapest, 2003.
2. "Turbulent Autoignition of Hydrogen and Acetylene in a Duct", **C.N. Markides** & E. Mastorakos, *The Combustion Institute (French Section) & CNRS European Combustion Meeting*, Orléans, 2003.
3. "An Experimental Study of Hydrogen Autoignition in a Turbulent Co-Flow of Heated Air", **C.N. Markides** & E. Mastorakos, *The Combustion Institute & University of Chicago 30th International Symposium on Combustion*, Chicago, 2004.
4. "Experiments on the Autoignition of Ethylene Injected Concentrically into Confined Annular Jets of Hot Air", **C.N. Markides** & E. Mastorakos, *The Combustion Institute (Belgian Section) & Université Catholique de Louvain European Combustion Meeting*, Louvain-la-Neuve, 2005.
5. "Measurements and Simulations of Mixing and Autoignition of an n-Heptane Plume in a Turbulent Flow of Heated Air", **C.N. Markides**, G. De Paola & E. Mastorakos, *The Combustion Institute (Mediterranean Sections), ICHMT & Instituto Superior Tecnico 4th Mediterranean Combustion Symposium*, Lisbon, 2005. **Best Paper Award**.
6. "Measurements of Scalar Dissipation in a Turbulent Plume with Planar Laser-Induced Fluorescence of Acetone", **C.N. Markides** & E. Mastorakos, *Institution of Chemical Engineers & Kings College London Fluid Mixing VIII*, London, 2006.
7. "Flame Propagation Following the Autoignition of Axisymmetric Hydrogen, Acetylene and Normal-Heptane Plumes in Turbulent Co-flows of Hot Air", **C.N. Markides** & E. Mastorakos, *ASME 51st Turbo Expo*, Barcelona, 2006.
8. "Measurements of the Statistical Distribution of the Scalar Dissipation Rate in a Turbulent Axisymmetric Plume", **C.N. Markides** & E. Mastorakos, *ICHMT 5th International Symposium on Turbulence, Heat and Mass Transfer*, Dubrovnik, 2006, abstract submitted.

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AWARDS AND SCHOLARSHIPS

- 2006: **Best Paper** presented at the 4th Mediterranean Combustion Symposium, voted by the International Centre for Heat and Mass Transfer (ICHMT) organizers.
- 2005: **John Winbolt Prize** by University of Cambridge for **Best Journal Paper** written by a Ph.D. student.
- 2002 – 2004: **Educational Grant** by A.G. Leventis Foundation (Paris) for Ph.D. based on **overall academic performance** after **worldwide competition** and renewed until end of my studies after additional competition.
- 2001: **Three-year Bursary** by Cambridge Commonwealth Trust (CCT) for Ph.D. studies **offered exceptionally and based on previous academic performance** within the University.
- 2001: **Clare College Prize** in recognition of the previous year's **overall academic performance**.
- 1998 – 2001: Three **Pressed-Steel Prizes for Engineering** in recognition of each year's **exam results**.
- 1998 – 2000: **Foundation Scholarship** for two years running in recognition of **academic performance**.
- 1998: **Prize for best design** in a Structural Design Project awarded by the Engineering Department.
- 1997 – 2001: Awarded **4-year Bursary** by the Cambridge Commonwealth Trust towards the M.Eng. degree.
- 1997: Admitted to the status of **'Fellow of the Cambridge Commonwealth Society'** and **'Malaysian Commonwealth Scholar'**.
- 1997: Successfully **proposed by the Cypriot Ministry of National Economy** for a bursary towards the B.A. in Cambridge based on **academic performance, potential for application of knowledge gained and involvement in future socio-economic development of the island**.
- 1997: **Honorary Plaque** presented during ceremony by army unit commander and his Senior Officer for **exceptional services and conduct**. Also, **First Prize** in regional shooting competition.
- 1995: **Special Graduation Diploma** presented for **First Place in Army Officer Exams** in Greece.
- 1994 – 1995: **Honorary Mention** from the 'Cyprus Company of Physics' two years running for having environment and technology **projects in top six positions of a nationwide competition**.
- 1992: 'Cyprus Mathematical Company' **Honorary Diploma** for **nationwide maths competition**.
- 1992: **Number of Prizes for best results in Mathematics and Chemistry school competitions**.
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OTHER SKILLS AND INTERESTS

Spoken Languages:

Greek (Mother Tongue), English (Fluent/First Language), French and Italian (Basic).

Information Technology/Computers:

Experienced programmer in Basic, C++, FORTRAN and HTML. Advanced knowledge of Windows and Unix operating systems. Advanced user of the MATLAB mathematical package, SPSS statistical toolbox, Photoshop and Illustrator graphics programs and majority of office software packages. Basic CAD (Computer Aided Drawing) skills.

Driving Licence:

Full, clean Cypriot driving licence since 1996. Also, up to 5 Tonne truck military driving licence since 1995.

Music:

Self-taught acoustic and electric guitarist and mandolin player. Have played live for audiences at local concerts.

Sailing:

Both as a captain and crew I have been a member of the Cyprus National Sailing Team and a national 470 Class champion. Also a member of the Cambridge University Sailing Team during 1998 – 1999. Passed an exam in Rules of Vessel Engagement at Sea to become a qualified Racing Umpire and Protest Committee Judge. Have been involved in organising regattas and training younger sailors.

Swimming:

Member of Cyprus National Swimming Team until 1992. Silver and Bronze medals at national championships.

Travelling:

Have lived in South Africa, Cyprus, England and Greece and visited Belgium, Egypt, France, Germany, Holland, Hungary, Israel, Italy, Romania, Russia, Scotland, Spain and the USA.

Other:

First aid, reading, writing, remote controlled model airplanes, boats and cars.

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REFEREES

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ONLINE REFERENCES

1. <http://www2.eng.cam.ac.uk/~cnm24>
2. <http://www.eng.cam.ac.uk/~cnm24>
3. <http://www-g.eng.cam.ac.uk/energy>
4. http://www-g.eng.cam.ac.uk/energy/nondasresearch/group_new/Research_Themes/Autoignition.htm
5. <http://www2.eng.cam.ac.uk/~rb326/groupmain/Autoignition.html>
6. <http://www.eng.cam.ac.uk/research/sustainablepage.shtml>
7. <http://www-g.eng.cam.ac.uk/mmg/environmental/smithmarkides1.html>
8. <http://www-g.eng.cam.ac.uk/mmg/environmental/smithmarkides2.html>
9. <http://www.thermofluidics.com>

Christos N. Markides
6th of April, 2006