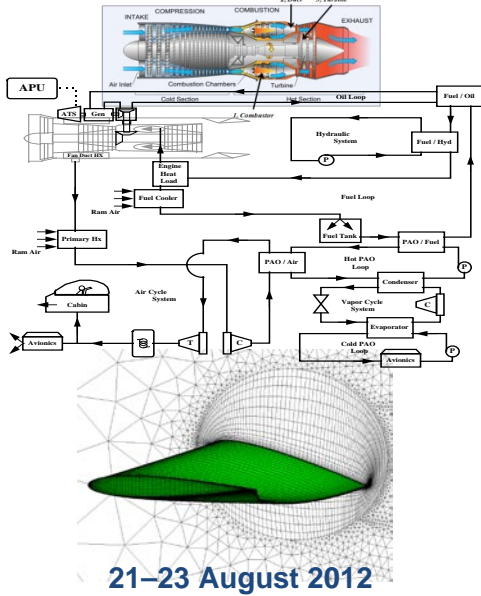




**VON KARMAN INSTITUTE
FOR FLUID DYNAMICS
VKI Lecture Series**

**Physics-Based Modeling &
Simulation for Aerospace Systems**



21–23 August 2012

Location:

Wright State University (Ohio, USA)



**WRIGHT STATE
UNIVERSITY**



We wish to thank the following for their contribution to the success of this conference:

Department of the Navy, Office of Naval Research,
and the United States Air Force Research Laboratory
<http://www.navy.mil>



INTRODUCTION

Aircraft have evolved into extremely complex machines, posing a highly integrated design challenge. Some of the systems also generate by-products in the form of heat that must be carefully addressed. Methods exist for the design of all these systems based on evolutionary vehicle development. However, the more we depart from existing databases and experience levels, the less confident we are in an optimal design. In addition, many of the classical techniques remain constrained by the simplifying assumptions of quasi-steady, quasi-equilibrium, etc. If these assumptions are not considered, there is no guide as to when those classical techniques no longer give an energy-optimal solution.

In general, the purpose of this short-course is to explain and develop the theory of physics-based design and analysis. One objective of this lecture series is to present a common design currency in the form of “exergy,” as the potential work available from an energy source. Validating examples using the concept of exergy as an objective function are provided. The course will start with a general lecture covering fundamentals. Then the basics of the method will be presented followed by applications of the basic theory. The course will continue the second day with discussions of subsonic vehicle, gas turbine and combustion applications. Finally, hypersonic analysis will be presented, followed by discussions on the mathematical foundations for physics-based design space exploration and visualization.

This short course is a unique opportunity to bring together experts from different areas and raise fruitful discussions. Together, the application of physics-based methods at all levels of flight vehicle design will be presented. The notes will provide a good basis for engineers working in all areas of vehicle design. The directors of this Lecture Series are Dr. Mitch Wolff from Wright State University and Dr. Guillermo Paniagua from the von Karman Institute for Fluid Dynamics.

TIMETABLE

TUESDAY 21 AUGUST 2012

- 08.20 Registration
- 09.00 **Welcome, introductory remarks**
Dr. Mitch Wolff
- 09.30 **Systems Fundamentals**
Dr. David Moorhouse, MSTC (retired)
- 10.15 **Theoretical Foundations**
Dr. José Camberos, AFRL – MSTC
- 14.00 **Systems Applications**
Prof John Doty, AFRL–UD–DCS
- 15.45 **Hypersonic Systems MDAO**
Dr. Kevin Bowcutt, Boeing Aerospace

WEDNESDAY 22 AUGUST 2012

- 09.00 **Subsonic Aerodynamics**
Prof Richard Figliola, Clemson U
- 11.00 **Applications Propulsion Analysis**
Dr. Bryce Roth, GE Aviation
- 14.00 **Propulsion Systems Modeling**
Prof Tomas Grönstedt, Chalmers UT, Sweden
- 15.45 **High-Speed Aero-Propulsion Integration**
Prof. David Riggins, MST, USA

THURSDAY 23 AUGUST 2012

- 09.00 **Entropy Generation Minimization**
Prof Adrian Bejan, Duke University
- 11.00 **Integrated Mission-Level Analyses**
Prof Michael von Spakovsky, VaTech
- 14.00 **Mathematical Foundations for Physics-Based Simulations**
Dr. Larry Lambe, MSSRC USA
- 15.45 **Hyperspace Visualization for MDAO**
Prof Brian German, GaTech

KEYNOTE LUNCH-TIME ADDRESSES

Tuesday – Kevin Bowcutt, Ph. D. Boeing Aerospace
Hypersonic Technology Maturation & Flight Testing

Wednesday – Mr William E. Harrison III, AFRL
Operational Energy: a System of Systems View

Thursday – Prof Adrian Bejan, Duke University
Constructal Law & Design in Nature

HOW TO REGISTER

Register online on <https://events.vki.ac.be>. The registration deadline is the 14 August 2012. A letter of acceptance and additional information will be sent upon registration.

REGISTRATION FEE

The course fee of \$950 includes administrative costs, printed notes & coffee (lunch not included).

Under special arrangements, the registration fee is waived for Naval Research Enterprise (NRE) scientists designated by ONRG, AFRL personnel, contractors, and DAGSI Institutions (Wright State Univ., University of Dayton, and Air Force Institute of Technology).

FELLOWSHIPS

To encourage greater participation in the Lecture Series by university members, a limited number of student fellowships will be made available. Recipients are entitled to attend the Lecture Series at a reduced fee, which will be \$500 for assistants without a Ph.D. degree and for Ph.D. candidates, and \$270 for undergraduate students. The fee is applicable for all NATO citizens.

A letter requesting a Fellowship must accompany the registration form, together with a recommendation letter from his or her advisor or mentor. A Fellowship request will not be considered without these letters.

All possible alternative sources of funding should be investigated before Fellowship aid is requested, so that those most in need will benefit.

METHODS OF PAYMENT

The payment should be done two weeks prior to the beginning of the course. Only two methods of payment are accepted:

1. By bank transfer to the VKI bank account.
IBAN: BE57 2100 3153 3035
SWIFT BIC CODE: GEBABEBB
Agency of the BNP Paribas Fortis Bank,
avenue de la Forêt de Soignes 322, 1640
Rhode-St-Genève, Belgium

The name of the participant and the title of the Lecture Series must be clearly indicated.

2. By Paypal on <https://events.vki.ac.be>. No Paypal account need, VISA, MasterCard, Amex available.

3. Or by returning a copy of this invoice with the following information to the VKI administrative office (e-mail: vanhaelen@vki.ac.be, FAX: +32 2 359 96 00):

NAME: _____

SERIES TITLE: _____

CHARGE TO:

☐ Visa ☐ MasterCard ☐ AMEX ☐ DinersClub

For an amount of _____ USA Dollars

CARD HOLDER _____

NUMBER:

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EXP DATE: ____/____/____

SIGNATURE: _____

Printed notes will be distributed during registration. Proceedings of other VKI Lecture Series may be purchased at VKI (e-mail: vanhaelen@vki.ac.be). Information can be found on the VKI web site <https://www.vki.ac.be>.

LOCATION AND TRANSPORT

The Lecture Series will take place at the Wright State University Lecture Theatre. Wright State University is located in Dayton, Ohio, approximately 70 miles west of the state capital, Columbus. Air transportation is provided by several major airlines to Dayton International Airport, located about 25 minutes from the campus. Ground transportation to campus from the airport is provided by rental car or taxi. Dayton is served by interstate highways 70 and 75, which intersect just north of the city.

ACCOMMODATION

To ensure reservation at a special rate, participants are advised to make hotel reservations as early as possible, mentioning the Group Name, "VKI LS." The recommended hotels near the campus (~1 mi) are listed in the table below. Daily rates are given in US Dollars.

| | Single or Double |
|-------------------------|------------------|
| Holiday Inn | |
| 2800 Presidential Drive | \$ 95.00 |
| Fairborn, OH 45324 | Per night |
| (937) 426-7800 | |

<http://www.ichotelsgroup.com/h/d/HI/hd/fbnpd>

| | |
|-------------------------|-----------|
| Homewood Suites | |
| 2750 Presidential Drive | \$109.00 |
| Fairborn, OH 45324 | Per night |
| (937) 429-0600 | |

<http://www.homewood-suites.com/>

| | |
|--------------------------|-----------|
| Red Roof Inn | |
| 2580 Colonel Glenn Drive | \$54.99 |
| Fairborn, OH 45324 | Per night |
| (937) 426-6116 | |

<http://www.redroof.com/reservations>