



Drodzy Studenci i Doktoranci Wydziału Mechanicznego Energetyki i Lotnictwa,

Mam przyjemność poinformować, że w najbliższym czasie (vide podany dalej harmonogram zajęć) uruchomiony zostanie na Wydziale MEiL przedmiot obieralny pt. *Intelligent Mobility*. Wykłady poprowadzi Pan Profesor Rafał Żbikowski (zatrudniony w Control Engineering School of Aerospace, Transport and Manufacturing Institute of Aerospace Sciences Centre for Cyber-Physical Systems, Cranfield University) - profesor wizytujący PW w ramach projektu „Program rozwoju dydaktycznego Wydziału Mechanicznego Energetyki i Lotnictwa PW” finansowanego ze środków Programu Operacyjnego Kapitał Ludzki. Profesor Rafał Żbikowski jest wybitnym specjalistą w dziedzinie szeroko pojętej techniki lotniczej, bezzałogowych statków powietrznych, mechaniki, teorii sterowania oraz projektowania i modelowania złożonych systemów technicznych i cybernetycznych.

### **Opis zawartości merytorycznej kursu i jej związek z aktualnymi trendami rozwojowymi w technice.**

The proposed series of 15 lectures units (45 minutes for each unit) focuses on the emerging subject of Intelligent Mobility, interpreted as the Cyber-Physical System of Networked Motion. This subject is a cutting-edge technology of scientific interest, and an area which is, and will be, an in-demand activity with appropriate funding already allocated in the EU Horizon 2020 programme.

Intelligent Mobility is a cyber-physical integration and expansion of the existing and planned networks, encompassing:

- Road / air / maritime transportation network
- Wireless and wired communication network
- Digital computation and processing network

Intelligent Mobility is a network of networks whose design can be done in two main ways:

1. Design of components within each network
2. Design of interdependence among the networks

*Component design for Intelligent Mobility* is constrained by the design drivers, legacy and network-specific limitations. In practice, it is to be expected that gradual retrofitting / upgrading of the existing network components will be a route for improvement.

*Interdependence design for Intelligent Mobility* means connecting largely separate networks in new ways and offers greater scope for novel, high-performance design. Hence, the main focus of these lectures is the interdependence design.

A notable element of the proposed lecture series is the interpretation of Intelligent Mobility as the Cyber-Physical System of Networked Motion. Cyber-Physical Systems (CPS) are engineered systems which have significant couplings between cyber (processing, communication, network) and physical (sensing, actuation, infrastructure) elements. These couplings result in highly-dynamic co-evolution of cyber and physical properties. The analysis and design of CPS requires understanding of the joint dynamics of computers, software, networks, and physical process.

The “cyber” part of Cyber-Physical Systems is generic to all such systems due to the fundamental structure of existing computer and communication networks. However, the “physical” part of CPS is subject-specific and requires involvement of the relevant experts, e.g., Aeronautical, Automotive etc.



Such experts need to understand the “cyber” element of Intelligent Mobility in order to be able to propose technically viable and commercially successful solutions either for Component Design or Interdependence Design (or both). Hence, the focus of this lecture series is the “cyber” element of Intelligent Mobility with emphasis on how the characteristics of that element impact on the relevant cyber-physical couplings. A key issue in the CPS analysis and design is the understanding and influencing of the network behaviour, both as a single entity binding CPS elements and also in the broader context of the network of networks. This lecture series will address two questions:

1. Resilience of interdependent networks
2. Performance of packet-switched networks

Finally, the CPS perspective is useful not only for a proper and convenient interpretation of Intelligent Mobility, as the Cyber-Physical System of Networked Motion, but also as an opportunity to understand the potential and challenges of the broad subject of Cyber-Physical Systems. That subject is prominently recognised in the EU Horizon 2020 programme and appreciated as important by European and International Industry.

### **Organizacja kursu**

Zajęcia w przedmiotu *Intelligent Mobility* obejmą 5 trzygodzinnych i prowadzonych w języku angielskim wykładów wg podanego niżej harmonogramu. Całkowita objętość kursu to 15 godzin, a liczba punktów ECTS – 2. Zajęcia będą prowadzone na terenie Instytutu Techniki Lotniczej i Mechaniki Stosowanej PW (ul. Nowowiejska 24), w godzinach **17.15-20.00**. Warunki zaliczenia zostaną podane na pierwszym wykładzie.

### **Harmonogram wykładów (schedule)**

<b>October 20<sup>th</sup> 2015</b>	Motivation and background. Basics of Cyber-Physical Systems. Complex networks – basics.	Room A2
<b>October 21<sup>th</sup> 2015</b>	Complex networks – Erdős-Rényi, Watts-Strogatz and Barabási-Albert models	Room A1
<b>October 22<sup>th</sup> 2015</b>	Complex networks: correlation structures, models and reality. Interdependent networks – motivation.	Room A1
<b>October 27<sup>th</sup> 2015</b>	Interdependent networks – coupled failures. Cyber Safety – principles and case study.	Room A2
<b>October 28<sup>th</sup> 2015</b>	Performance of packet-switched networks	Room A1

Wszystkich zainteresowanych udziałem w kursie *Intelligent Mobility* proszę uprzejmie o jak najszybsze zgłoszenie chęci uczestnictwa pocztą elektroniczną na adres [jasz@meil.pw.edu.pl](mailto:jasz@meil.pw.edu.pl) lub [magda@meil.pw.edu.pl](mailto:magda@meil.pw.edu.pl).

Pozdrawiam

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**KAPITAŁ LUDZKI**  
NARODOWA STRATEGIA SPÓJNOŚCI

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