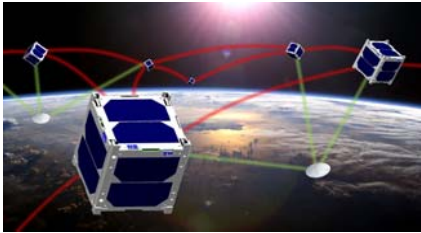




LECTURE SERIES  
SCI-209

on “Small Satellite Formations For Distributed Surveillance: System Design and Optimal Control Considerations”

sur “Constellations de petits satellites pour la surveillance distribuée : conception de systèmes et optimisation de contrôle”



organized by the

**Systems Concepts & Integration Panel**

to be held in

**USA, Stanford University on 1-2 April 2009**

**GERMANY, Würzburg on 6-7 April 2009**

**ITALY, Rome on 8-9 April 2009**

This Lecture Series is open to citizens from NATO, Partnership-for-Peace (PfP) Nations.

**Latest Enrolment Date**

NATO Nations **Wednesday, 25 March 2009**

PfP Nations **Wednesday, 18 March 2009**

Enrol on-line at <http://www.rta.nato.int/meetings.asp>

If you are unable to enrol via the internet, please use the attached enrolment form to enrol via fax.

**All presentations and discussions will be held in English.**

**Background**

The mission of RTO is to conduct and promote co-operative research and information exchange. RTO consists of a three level organization: the Research and Technology Board (RTB), the Panels and the Technical Teams. The Systems Concepts and Integration (SCI) panel is one of the seven Panels under the RTB.

The Mission of the SCI Panel is to advance knowledge concerning advanced systems, concepts, integration, engineering techniques and technologies across the spectrum of platforms and operating environments to assure cost-effective mission area capabilities.

**Theme**

In Earth observation, the innovation potential by employing a distributed network of satellites is obvious in order to provide higher temporal resolution in observation data and to achieve higher availability. Especially in emergency, surveillance and military observation tasks, such robust capabilities for observation are important. In case of failures, even graceful degradation capabilities are related to formations of satellites. Currently modern miniaturization techniques enable in parallel realization of satellites at continuously smaller masses, leading to decreased costs. Thus currently a paradigm shift in Earth observation from single large satellites to groups of smaller satellites is occurring.

This lecture series will focus on bridging the gap between theory and applications in satellites formations for Earth observation. The industrial, academic and military audience should be made aware of the application potential of this innovative approach and the enabling techniques. Thus in this lecture series essential techniques will be addressed, such as:

- mission planning for distributed satellite systems,
- system design aspects of small satellites,
- advanced control strategies for formations of satellites (sensors, actuators, software),
- typical Earth observation payloads,
- distributed sensor networks for Earth observation,
- Earth observation and sensor data fusion methods,
- establishment and operations of networks of low cost ground stations.

Thus the crucial system design challenges in implementing satellite formations for telecommunication and surveillance tasks are included.

**Thème**

Dans le domaine de l'observation de la Terre, le potentiel d'innovation représenté par l'emploi d'un réseau distribué de satellites est évident. Celui-ci permet d'améliorer la résolution temporelle des données observées et garantit une disponibilité plus élevée. Ces puissantes capacités d'observation sont particulièrement cruciales pour l'observation militaire, la surveillance et la réaction aux situations d'urgence. En cas de défaillances, les formations de satellites représentent un avantage évident, même pour les capacités à dégradation progressive. De plus, les techniques de miniaturisation modernes permettent de mettre au point des satellites de masse sans cesse plus réduite, donc de coût également réduit. C'est pourquoi l'observation de la Terre s'appuie progressivement non plus sur de gros satellites uniques, mais sur des groupes de satellites plus petits.

Cette série de conférences s'attachera à combler le fossé existant entre la théorie et les applications dans le domaine des formations de satellites destinées à l'observation de la Terre.

L'auditoire, composé de personnes provenant des milieux industriels, universitaires et militaires, doit être informé du potentiel d'application de cette approche novatrice et de ses techniques habilitantes.

Cette série de conférences s'attachera à combler le fossé existant entre la théorie et les applications dans le domaine des constellations de satellites destinées à l'observation de la Terre. L'auditoire, composé de personnes provenant des milieux industriels, universitaires et militaires, doit être sensibilisé sur le potentiel d'application de cette approche novatrice et des techniques habilitantes. Cette série de conférences traitera donc des techniques essentielles, notamment :

- la planification de missions et la sélection d'orbites pour les groupes de satellites,
- les aspects de la conception de systèmes des petits satellites,
- les stratégies de commandes avancées pour les formations de satellites (capteurs, commandes, logiciels),
- les charges utiles typiques pour l'observation de la Terre,
- les réseaux de capteurs distribués pour l'observation de la Terre,
- les méthodes de fusion de données des capteurs et de l'observation de la Terre
- l'établissement et l'exploitation de réseaux de stations terrestres à bas coûts

Les principaux défis de la conception de systèmes lors de la mise en œuvre de formations de satellites pour des missions de surveillance et de télécommunications seront ainsi abordés.

**Lecture Series Director**

**Prof. Dr. Klaus Schilling**  
Julius-Maximilians-University Würzburg  
Informatik VII: Robotics & Telematics  
Am Hubland  
97074 Würzburg  
Germany  
+49 931 888 6647  
schi@informatik.uni-wuerzburg.de

**Lecturers**

**Prof. Bob Twiggs**  
Stanford University  
USA  
bob.twiggs@stanford.edu

**Prof. Dr. Mario Garcia-Sanz**  
Public University of Navarra  
Automatic Control/Comp Science Department  
Spain  
mgsanz@unavarra.es

**Dr. Rainer Sandau**  
Institut für Weltraumsensorik  
und Planetenerkundung, DLR  
12489 Berlin-Adlershof, Germany  
rainer.sandau@dlr.de

**Local Enrolment Coordinators**

**USA, Stanford :**  
**Prof. Bob Twiggs**  
496 Lomita Mall  
Stanford, CA 94305-4035  
USA  
+ 1-650- 723-8651 (office)  
+ 1-650-723-1685 (fax)  
bob.twiggs@stanford.edu

**GERMANY, Würzburg :**  
**Prof. Dr. Klaus Schilling**  
Julius-Maximilians-University Würzburg  
Informatik VII: Robotics & Telematics  
Am Hubland  
97074 Würzburg  
Germany  
+49 931 888 6647  
schi@informatik.uni-wuerzburg.de

**ITALY, Rome :**  
**Filippo Graziani**  
Scuola di Ingegneria Aerospaziale  
University Sapienza di Roma  
via Eudossiana 16  
00184 Roma  
+39 06 44585 792 or 334  
+ 39 328789 7629 (cell)  
filippo.graziani@uniroma1.it

**RTA Contact**

**Mr. Nicolas Vandenabeele** Tel: +33 (0)1 55 61 22 14  
Operations and Coordination Division Fax: +33 (0)1 55 61 96 10  
RTA Paris VandenabeeleN@rta.nato.int

**Lecture Series Programme**

**DAY ONE**

- 08:30 REGISTRATION
- 09:00 OPENING CEREMONY  
National Authorities
- 09:15 Orbit design and mission analysis for surveillance  
satellites in low Earth orbits  
Prof. Dr. K. Schilling
- 10:30 COFFEE BREAK
- 11:00 Network communications & Application examples for LEO-  
satellite systems  
Prof. Dr. K. Schilling
- 12:00 LUNCH
- 13:30 Miniaturization techniques to realize very small satellites  
Prof. B. Twiggs
- 15:00 BREAK
- 15:30 Subsystem realization, actuators and sensors for satellite  
attitude control for very small satellites  
Prof. B. Twiggs
- 17:00 END

**DAY TWO**

- 09:00 MIMO QFT controller design reformulation. Application to  
spacecraft with flexible appendages  
Prof. Dr. M. Garcia-Sanz
- 10:30 COFFEE BREAK
- 11:00 MIMO QFT controller design reformulation. Application to  
spacecraft flying in formation in a low Earth orbit  
Prof. Dr. M. Garcia-Sanz
- 12:00 LUNCH
- 13:30 Satellite Earth observation and surveillance payloads  
Dr .R. Sandau
- 15:00 BREAK
- 15:30 Distributed Satellite Systems for Earth observation and  
surveillance  
Dr. R. Sandau
- 17:00 END

**APPLICATION TO ENROL  
LECTURE SERIES SCI-209**

- USA, Stanford University on 1-2 April 2009**
- GERMANY, Würzburg on 6-7 April 2009**
- ITALY, Rome on 8-9 April 2009**

Title (Prof, Dr, Mr, Mrs etc.): .....

Family name, first name: .....

Position: .....

I am an employee of Govt/Industry/Academia/Other: .....

Office address: .....

.....

Tel: ..... Fax: .....

E-mail: .....

Nationality: .....

Passport no: .....

Passport issued at (place): ..... on (date): .....

Date of birth: ..... Place of birth: .....

**Latest Enrolment Dates**

NATO Nations **Wednesday, 25 March 2009**

PfP Nations **Wednesday, 18 March 2009**

My role at the meeting will be:

<input type="checkbox"/>	RTO Member	<input type="checkbox"/>	Author
<input type="checkbox"/>	Co-Author	<input type="checkbox"/>	Other Participant

**For use of Enrolment Coordinator:**

I approve this application and have sent an information package.

Signed: \_\_\_\_\_ Date: \_\_\_\_\_

Please complete this form and send it to the Local Enrolment Coordinator who will, upon receipt of your application to enrol, forward a general information package which will include travel advice, recommended accommodation etc.