Keynotes & Tutorial

Keynote 1

Computational modelling of biological dynamics using 3D computer vision: application to microbial decomposition in soil.
by Olivier Monga
IRD, France

Abstract:
Information technology is becoming more and more a key tool to address global life sciences challenges. Within this context, computational biology is a growing area mainly due to the today crucial ecological questions such as for instance carbon sequestration. This talk deals with the simulation of microbial decomposition in soil at microscopic scale using advanced computer vision algorithms to represent 3D soil microstructures. In particular, this issue faces the still open problem of the intrinsic and compact representation of 3D complex natural geometrical structures. Our simulation tools based on graph and Partial Differential Equations are validated using real experimental data. This work belongs to the very first ones aiming at simulating, using real data, microbial decomposition in soil at micro scale (1-5 micron m) by taking into account 3D pore space representation. Such cross roads research can be very valuable for soil science in order to understand better soil microstructure impact on biological dynamics and also to evaluate biological scenarios difficult to implement experimentally. Same as for macroscopic physics versus quantic physics the final challenge is to understand relationships between biological phenomena at microscopic scale and at macroscopic scale. This refers to emerging properties, which is a fundamental issue in life sciences. Our methodology applies for any modelling problem where transformation, transport and diffusion processes occur simultaneously within complex 3D geometrical shapes. Therefore, it can be easily adapted for many other environment and medical applications.

References:
• Ngom N. F., Garnier P., Monga Olivier, “PETh S. Extraction of three-dimensional soil pore space from microtomography images using a geometrical approach,” Geoderma, 2011, 163 (1-2), p. 127-134. ISSN 0016-7061

Biography: Olivier MONGA is research director at IRD (France) formerly at INRIA (France). His research field is computer vision and its applications to complex system modeling. He gets his PhD degree in 1988 under the supervision of Pr. Olivier Faugeras and his habilitation to conduct researches in 1993 under the supervision of Pr. Nicholas
Ayache, at the university Paris 11 (Orsay). He published over 100 papers in international journals and conferences and wrote a reference book. (http://scholar.google.com/citations?user=IVEXVW0AAAAJ&hl=fr).

He was the founding director of sino-french laboratory LIAMA and the initiator and manager of European pilot projects ANFAS and SIMES. Recently, he brought a major contribution to ANR project MEPSOM which was selected as key project by ANR SYSCO program (Complex system mathematical modeling). (2009-2013, http://www.dailymotion.com/video/x10iw8u_projetmepsom_tech)

Keynote 2

Epidemics on networks
by Piet F. A. Van Mieghem
Delft University of Technology

Abstract:
After a brief introduction to complex networks, I will focus on SIS epidemics on networks. Besides the spread of biological viruses, epidemics also occur in digital networks under the disguise of malware or under the more positive inclination of information diffusion in (social) networks. From a fundamental point of view, epidemic processes on networks belong the "simplest" dynamic processes on networks, where the interplay between the process on and the topology of the network can be studied and understood. We will show why SIS epidemics on networks are so interesting.

Biography: Piet F. A. Van Mieghem is professor at the Delft University of Technology with a chair in telecommunication networks and chairman of the section Network Architectures and Services (NAS) since 1998. His main research interests lie in the modelling and analysis of complex networks (such as biological, brain, social, infrastructural, etc. networks) and in new Internet-like architectures and algorithms for future communications networks. He is the author of four books: Performance Analysis of Communications Networks and Systems, Data Communications Networking, Graph Spectra for Complex Networks, and Performance Analysis of Complex Networks and Systems. Currently, he serves on the editorial board of the OUP journal of Complex Networks and Computer Communications. Professor Van Mieghem received a Master and Ph. D. degree in Electrical Engineering from the K.U.Leuven (Belgium) in 1987 and 1991, respectively. Before joining Delft, he worked at the Interuniversity Micro Electronic Center (IMEC) from 1987 to 1991. During 1993 to 1998, he was a member of the Alcatel Corporate Research Center in Antwerp where he was engaged in performance analysis of ATM systems and in network architectural concepts of both ATM networks (PNNI) and the Internet. He was a visiting scientist at MIT (department of Electrical Engineering, 1992-1993) and a visiting professor at UCLA (department of Electrical Engineering, 2005) and at Cornell University (Center of Applied Mathematics, 2009). He was member of the editorial board of Computer Networks (2005-2006), of the IEEE/ACM Transactions on Networking (2008-2012) and of the Journal of Discrete Mathematics (2012-2014).
COLOR SHADES® spectral filters arrays: a new dimension for multispectral imaging

by Thierry Berthou
SILIOS, France

Abstract:
Custom 2D Spectral filter arrays to replace standard Bayer matrices for imagers is an emerging technology for multispectral imaging. They allow to downsize multispectral cameras and systems while keeping their advantages compared to standard RGB cameras. SILIOS Technologies is developing such spectral filters arrays based on its Color Shades® technology. The first part of the talk will present the technology and its evolution from spectrometry, with lower constraints, to multispectral imaging. The second part will show the developments made at SILIOS Technologies for multispectral imaging, the advantages of these spectral filters arrays and the progress and current development to improve the capacities of the technology as well as the next steps of evolution. The Color Shades® technology allows to choose the wavelengths range, the number of different wavelengths between 2 to 16, the size and shape of each filter. Applied to spectrometry, it offers the possibility to realize applications dedicated compact spectrometers and for imaging it brings multi-spectral capabilities to standards imagers. The Color Shades® technology brings a new dimension to spectral imaging thanks to its full versatility in terms of wavelengths choices, choice of the position of each different color-pixel in the matrix and to the possibility to match one filter per pixel. The Color Shades® Custom Bayer matrix is realized on a thin fused silica substrate which is reported face down on the sensitive part of the imager to avoid crosstalk. The current realizations are for the visible range (400 – 700nm) and the Near Infrared range (700-1000nm). The first matrices where made with 20x20µm² ranges and 4 wavelengths (RGB plus one NIR). The current realizations concern also 20x20µm² range pixels but with 7 visible range wavelengths and one NIR band and the future developments will lead to come down to imagers’ pixel size (i.e. ≤ 5 µm).

Biography: Thierry Berthou received the Engineering degree in optics from Ecole Nationale Supérieure de Physique de Marseille (now Centrale Marseille), France, in 1990. Between 1990 and 1992, as a development engineer and project manager, various optical complex systems and simulators such as an all-weather detection system and an image recognition system for a packet sorting robot were developed. Between 1993 and 1995 he was R&D Manager and led six projects within EUREKA, MAST, THERMIE, HYDROACARB, BRITÉ-EURAM programs. Since 1996 he has been Sales & Export Sales Manager for companies working in the fields of Radars, semiconductors and optics industries. He joined SILIOS in 2005 where he has been Project leader of a EUROSTARS project and Principal Investigator of 2 FP6-IST projects. He has authored more than 10 communications in various technological fields (corrosion inspection by Eddy-currents, Lithography using laser beam Interference, Diffractive Optics).