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Tutorial

"Emergent Computing for Natural and Social Complex Systems"

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Abstract

Complexity is inherent to living systems. The meaning of living systems complexity is based on continuous evolution of structural organizations crossed by energetic fluxes. The whole comprehension of all the interactions of the living systems components inside their environment is needed to understand them. As a major complexity property, we can say that the reduction of the complete interaction network of the components of a living system does not allow to understand it, breaking with its complexity. The current natural and social World deals with this complexity property and need an accurate comprehension of this complexity, both for environmental purposes and for economical or geopolitic purposes. The Earth ecosystem equilibrium evolution is nowadays highlighted by local perturbations generated by human development and deep climatic perturbations could result of that. Geopolitic is also nowadays in fast and deep evolution as the result of the intensive development of modern communication processes which has transformed the old geographical cultural clustering. Interaction networks and patterns of emergent organizations are the keys of complex systems concepts understanding with which the current world must deal. Dissipative structures (following I. Prigogine) are the basis of the energetic approaches of self-organization criticality phenomena. We will present how computer science which can be considered as the science of modelling, dealing with information theory and systems conception can propose today, some models for self-organization processes. Cellular automata, sand pile models, segregation models (based on the works of the nobel price Thomas Schelling), agent-based modelling, social insects modelling for swarm intelligence can be the basis of relevent simulations for a better understanding of natural, economical or geopolitical systems that we have to face today.

Speaker Short Biography

Cyrille Bertelle is professor in Computer Science in Le Havre University, France. He is director of Le Havre component of LITIS which is the research laboratories aggregation of Computer Science, Information Technologies and Systems in Haute-Normandie region. This research center is labelled by the French Ministery of High Education and Research (EA 4051) and include more than 150 researchers (half of them are professors and assistant professors and half of them are PhD students). Professor Cyrille Bertelle is also co-director of Le Havre University Master of Science in Mathematics and Computer Science. He manages the research orientation of this master (MIASC) specialized in complex systems modelling. He contributes to many international conferences organizations. During the last year, he has managed the organization of 3 international workshops: "Emergent Properties in Natural and Artificial Dynamic Systems" in ECSS 2005, Paris, France, November 2005, "Modeling, Computation and Systems" in IEEE-ICECS 2005, Gamarth, Tunisia, December 2005, "Complex Systems and Self-organization Modelling" in ESM 2006, Toulouse, France, October 2006. He has edited 2 books in 2006 for Springer Verlag "Understanding Complex Systems" collection and for ESM 2006 conferences proceedings.

Speaker Recent Publications (2006)

Edited Books

- M.A. Aziz-Alaoui and C. Bertelle (eds)
  « Emergent Properties in Natural and Artificial Dynamical Systems »
  Springer (ISBN 3-540-34822-0), 2006.

- A. Nketsa, M. Paludetto and C. Bertelle (eds)
  « **The European Simulation and Modelling Conference 2006** »
  Eurosis-Eti publication (ISBN 90-77381-30-9), 2006

Book Chapters

- P. Tranouez, C. Bertelle and D. Olivier
  « **Changing Levels of Description in a Fluid Flow Simulation** »
  in M.A. Aziz-Alaoui and C. Bertelle (eds), *Emergent Properties in Natural and Artificial Dynamical Systems*, pp 89-101, Springer, 2006.

- R. Ghnemat, S. Oqeili, C. Bertelle and G.H.E. Duchamp
  « Automata-Based Adaptive Behavior for Economic Modelling Using Game Theory »
  in M.A. Aziz-Alaoui and C. Bertelle (eds), *Emergent Properties in Natural and Artificial Dynamical Systems*, pp 173-185, Springer, 2006.

International journals

- H. Kadri-Dahmani, C. Bertelle, G.H.E. Duchamp and A. Osmani
  « **Consistent Updating of Geographical DataBase as Emergent Property over Influence System** »
  Int. Journal of Modeling, Identification and Control, Special Issue *"Modelling Complex Systems"*, 2006.

- L. Jaff, G.H.E. Duchamp and C. Bertelle
  « Shift Operators and Complex Systems »
  Int. Journal of Modeling, Identification and Control, Special Issue *"Modelling Complex Systems"*, 2006.

- C. Bertelle, A. Dutot, F. Guinand, and D. Olivier
  « Organization Detection for Dynamics Load Balancing in Individual-Based Simulations »
  Int. Journal Multi-Agent and Grid Systems, Special Issue *"Nature-Inspired Systems for Parallel, Asynchronous and Decentralized Environments"*, 2006.

- C. Bertelle, A. Dutot, F. Guinand, and D. Olivier
  « Organization Detection using Emergent Computing »
  Int. Transactions on Systems Science and Applications, Special Issue *"Self-Organizing, Self-Managing Computing and Communications"*, 2006.

International conferences

- C. Bertelle, A. Dutot, F. Guinand, and D. Olivier
  « Organization Detection Using Emergent Computing »
  In Proceedings of *SOAS'2006*, Erfurt, Germany, September 18-20, 2006.

- H. Kadri-Dahmani, G.H.E. Duchamp, R. Ghnemat, H. Hadj-Kacem and C. Bertelle
  « Emerging Decision Support System for Geographical Information Systems »
  in Proceedings of *ECELM-2*, pp 78-90, Tirgu-Mures, Romania, May 31 - June 3, 2006.

- L. Jaff, G.H.E. Duchamp, H. Hadj-Kacem and C. Bertelle
  « Moderate Growth Time Series for Dynamic Combinatorics Modelisation »
  in Proceedings of *ECELM-2*, pp 42-53, Tirgu-Mures, Romania, May 31 - June 3, 2006.

- H. Kadri-Dahmani, C. Bertelle, G.H.E. Duchamp and A. Osmani
  « The evolution process of geographical data base within self-organized topological propagation area »
  in Proceedings of ESM 2006, pp 415-419, Toulouse, France, October 23-25, 2006.

- R. Ghnemat, C. Bertelle and G.H.E. Duchamp
  « Self-organisation simulation over geographical information system based on multi-agent platform »
  in Proceedings of ESM 2006, pp 420-424, Toulouse, France, October 23-25, 2006.

- A. Duperret, C. Bertelle and P. Laville
  « Cliff collapse hazards spatio-temporal modelling through GIS: From parameters determination to multi-scale approach »
  in Proceedings of ESM 2006, pp 425-429, Toulouse, France, October 23-25, 2006.

- G. Prevost and C. Bertelle
  « Decision and reification of emerging systems in population dynamics simulations »
  in Proceedings of ESM 2006, pp 471-477, Toulouse, France, October 23-25, 2006.

- G. Prevost and C. Bertelle
  « Model and Simulation Engineering in the Fieldof Ecology using web and Ontology and XML »
  in Proceedings of ESM 2006, pp 478-482, Toulouse, France, October 23-25, 2006.

- Z. Odibat and C. Bertelle
  « Application of homotopy perturbation method for ecosystems modelling »
  in Proceedings of ESM 2006, pp 483-487, Toulouse, France, October 23-25, 2006.