Complex Adaptive Systems, Publication 4  
Cihan H. Dagli, Editor in Chief  
Conference Organized by Missouri University of Science and Technology  
2014-Philadelphia, PA

Conquering Complexity: Challenges and Opportunities

Preface

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Multi-faceted systems of the future will entail complex logic and reasoning with many levels of reasoning in intricate arrangement. The organization of these systems involves a web of connections and demonstrates self-driven adaptability. They are designed for autonomy and may exhibit emergent behavior that can be visualized. Our quest continues to handle complexities, design and operation of these systems.

In April 2014 HRL Laboratories, LLC in Malibu, California announced that they successfully mapped HRL’s neuromorphic video object recognition algorithms to a spike-domain neural computational framework “Systems of Neuromorphic Adaptive Plastic Scalable Electronics (SyNAPSE)”. Hence, it is possible to develop an unattended, stand-alone autonomous object-recognition system that could operate without human supervision under a wide range of day or night environmental conditions. These algorithms emulate the visual processing flow of the mammalian brain using spike-based computations. This makes them accurate and efficient. SyNAPSE allows implementation of these algorithms up to 500 times more energy-efficient than conventional computers.

Another development to note is; Deep Learning algorithms that can provide adaptive behavior to complex systems of large-scale distributed networks through leveraging the big data.

All these recent developments are helping us to understand Complex Adaptive Systems. They are at the edge of chaos as they maintain dynamic stability through constant self-adjustment and evolution. As shown in figure below chaos and order are two complementary states of our world.
A dynamic balance exists between these two states. Order and structure are vital to life. Order ensures consistency and predictability and makes the creation of systems possible. However, too much order leads to rigidity and suppresses creativity. Chaos constantly changes the environment creating disorder and instability but can also lead to emergent behavior and allows novelty and creativity. Thus, sufficient order is necessary for a system to maintain an ongoing identity, along with enough chaos to ensure growth and development.

The challenge in Complex Adaptive Systems design is to design an organized complexity that will allow a system to achieve its goals. The 2014 Complex Adaptive Systems conference pushed the boundaries of research in complexity, by identifying challenges and opportunities.

This publication of the Complex Adaptive Systems Proceedings series contains the edited versions of the technical presentations of Complex Adaptive Systems, which was held November 3-5, 2014 in Philadelphia, Pennsylvania U.S.A. The extended version of each selected paper was reviewed by two referees, and then revised, edited and condensed to the format herein. The proceedings have nine parts: System Modeling and Design, System of Systems, Computational Complexity, Business and Financial Analytics, Data Science and Analytics, Cyber Physical Systems, Socio-Technical Systems, Healthcare Analytics and Adaptive Systems.

I would like to once again thank the conference co-chairs: Dr. Nil Ergin, Dr. Babak Heydari, Mr. Fred Highland, Dr. David Enke, Dr. Mika Sato-Ilic, Dr. Gursel Serpen, Dr. Douglas Bodner, and Dr. Iren Valova, and the authors for their contributions to this volume of proceedings and presentations at the conference. Further I wish to express my gratitude to all referees for their comments and suggestions for revising the papers.

I would like to mention our appreciation to the conference sponsors for bringing real life dimension, issues and engineering problems to the meeting. I would also like to thank Sue Turner, Latesha Zach and Cathi Barth for all their help and efforts enabling me to sail smoothly in the organization of this conference and production of this volume.

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St. Louis, Missouri, U.S.A.  
September, 2014