

MAE Seminar Series

Using Artificial Evolution to study physical phenomena

Michele Milano

Assistant Professor

Department of Mechanical and Aerospace Engineering
Arizona State University

Abstract

Trial and error experimentation is one of the main means of collecting data for the purpose of understanding the underlying physics of a system. Experimenter's judgment is often the only way to assess the quality of the data collected, and to decide what to try next. The results of this process may be affected by subjective bias, and often some correlations might be overlooked, thus missing important details. Machine Learning techniques can be used to automate trial and error search processes; this seminar presents a class of evolutionary algorithms that seek optimal regions rather than single optimal solutions for an optimization problem. Evolutionary algorithms minimize the number of trials necessary to arrive to a solution, and the study of the set of optimal solutions provides the data that are needed to gain a physical understanding in a fully automated way. Various sample applications will be illustrated, including a thorough study of flapping flight for fruit flies. Evolutionary optimization will drive the understanding of fluid dynamics principles underlying the evolution of both the flapping trajectory and the wing shape that optimize aerodynamic efficiency for fruit flies.

Speaker Biography

Dr. Milano is an Assistant Professor in the Department of Mechanical and Aerospace Engineering, Arizona State University, since August 2006. Prior to joining ASU he was at Caltech, where he worked in the divisions of Aeronautics and Bioengineering as a postdoctoral scholar and later a senior postdoctoral scholar; while working at Caltech, he has been awarded the Demetriades-Tsafka prize for innovative research in Bioengineering. He earned his M.S. in Electric Engineering with a concentration in Control theory, from University "Federico II" in Napoli, Italy, and his Ph.D. in Technical Sciences from the Swiss Federal Institute of Technology, in Zuerich, Switzerland. Dr. Milano's interests span the fields of optimization, mathematical modeling of complex systems, aerodynamics of insect flight, biologically inspired propulsion systems, and modeling of the left ventricle of the heart. Some notable publications include articles that demonstrate the aerodynamic efficiency of insect flight, the introduction of a new class of stochastic optimization algorithms, and a novel mathematical model for the heart's left ventricle.

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Please contact Dr. Matthew Ringuette (ringum@buffalo.edu) for additional information