The talk will present our research at the Biomedical Cybernetics Group that I established about three years ago in Dresden. We adopt a transdisciplinary approach integrating information theory, machine learning and network science to investigate the physics of adaptive processes that characterize complex interacting systems at different scales, from molecules to ecosystems, with a particular attention to biology and medicine. Our theoretical effort is to translate advanced mathematical paradigms typically adopted in theoretical physics (such as topology, network and manifold theory) to characterize many-body interactions in complex systems and quantitative biomedicine. We apply the theoretical frameworks we invent in the mission to develop computational tools for systems and network analysis. In particular, in biomedicine we deal with: prediction of wiring in biological networks, combinatorial and multiscale biomarkers design, precision biomedicine, drug repositioning and combinatorial drug therapy. In general, we devise theoretical models of structural organization in complex networks and we leverage this knowledge to create novel and more efficient bioinspired algorithms and to perform advanced analyses and predictions of patterns in complex systems.
Dr. Carlo Vittorio Cannistraci
Biomedical Cybernetics Group
Technical University Dresden

Carlo Vittorio Cannistraci is a theoretical engineer with a background in biomedical cybernetics. He is currently head of the Biomedical Cybernetics Group at the Centre for Molecular and Cellular Bioengineering (CMCB) and faculty member of the Department of Physics in the Technical University Dresden. His area of research embraces information theory, machine learning and complex network theory including also applications in computational network and systems biomedicine.

Nature Biotechnology selected Carlo’s article (Cell 2010) on machine learning in developmental biology to be nominated in the list of 2010 notable breakthroughs in computational biology. Circulation Research featured Carlo’s work (Circulation Research 2012) on leveraging a cardiovascular systems biology strategy to predict future outcomes in heart attacks, commenting: “a space-aged evaluation using computational biology”.

The Technical University Dresden honoured Carlo of the Young Investigator Award 2016 in Physics for his recent work on the local-community-paradigm theory and link prediction in monopartite1 and bipartite2 networks.

References (* indicates first co-authorship)