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Application of Deep Learning to Physical Sciences

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Abstract: I will present two scientifically diverse studies that illustrate the power of deep learning methods for advancing scientific discovery. The first study demonstrates automatic image classification of heterogenous landscape imagery with the overall goal of change detection of landscape evolution. The second study is about estimation of precipitation morphology utilizing space-born Passive Microwave (PMW) instruments, part of the Global Precipitation Measurement (GPM) mission, which is a long term mission at NASA. Deep learning methods demonstrate significant improvement in precipitation retrieval performance when compared with the currently deployed, state-of-the art methods. These studies could initiate development of novel neural network architectures that maximize information extraction from complex scientific datasets. However, purely data-driven methods can be exploited by adversaries navigating deep learning models into making desired errors. The future trends in deep learning, and AI in general, are moving toward enabling systems with neural networks to do decision making in context, which could also enhance understanding of deep learning models and further scientific discovery. Mission context is something that dynamically changes depending on the mission parameters and environment conditions and is far more tunable than reformulating the whole expert annotated dataset used for network training, making the system more robust to adversarial attacks. I will address opportunities to expand on presented work in this context.

Biography: Dr. Marko Orescanin is a Principal Machine Learning Engineer working at Bose and lecturing Data Science in the CS Department CSUMB. His work in the commercial environment and his research are currently focused on machine learning and deep learning methods applied to audio/acoustics, embedded systems and natural sciences. He holds a PhD in Electrical and Computer Engineering from University of Illinois at Urbana-Champaign.