Institute for Space Weather Sciences Colloquium

Thursday, 7th of December 2023, 1pm ET

via njit.webex.com, meeting ID: 2621 447 3191, password: isws

Dr. Christoph Keller, Lowell Observatory

Data-driven radiative hydrodynamics simulations of the solar photosphere using physics-informed neural networks

Current, realistic numerical simulations of the solar atmosphere reproduce observations in a statistical sense; they do not exactly reproduce observations such as a movie of solar granulation. Physics-informed neural networks (PINNs) offer a new approach to solving the time-dependent radiative hydrodynamics equations that easily includes observations as boundary conditions. PINNs approximate the solution of the integro-differential equations with a deep neural network. The parameters of this network are determined by minimizing the residuals with respect to the physics equations and the observations. The resulting models are continuous in all dimensions, can zoom into local areas of interest in space and time, and provide information on physical parameters that are not necessarily directly observed such as horizontal velocities. I will present an introduction to PINNs and their application to the solar photosphere along with the first validation of this novel approach, and provide an outlook to the many applications that this novel approach enables.

Dr. Christoph Keller joined Lowell Observatory as the Director of Science in early 2022. His research expertise includes (exo-)planets, solar and stellar magnetic fields, aerosols and trace gases in planetary atmospheres as well as innovative optical instruments for astronomy, remote sensing and biomedical imaging. He has authored or co-authored almost 400 publications and received the Friedrich Wilhelm Bessel award for outstanding research in astrophysics. He is a world-leading expert in high-accuracy polarimetry for astronomy and environmental sensing with the world's largest telescopes and the latest space instruments for climate science.