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**Abstract**

Transition metal-oxides with strongly interacting degrees of freedom can support a range of exotic functional properties (superconductivity, ferroelectricity, ferromagnetism, etc.) of interest for current and next-generation actuators, sensors, energy harvesters, passive and active microelectronic components and much more. Through the use of epitaxial strain engineering it is possible to control the subtle interplay between landau, elastic, electrostatic, and gradient energy creating exotic functional structures and responses. Here, I show how advanced thin film synthesis, in conjunction with custom multidimensional piezoresponse force spectroscopies and machine learning are providing new insights into ferroic response at multiple length and time scales. In particular, I will present how sequence-to-sequence deep artificial neural networks can be used to unravel new understanding of field-driven responses in polar systems with strain-induced structural competition. Finally, I will discuss my prospectus on the future of data science and artificial intelligence in reshaping our approach to experimental science.

**Biography**

Joshua C. Agar is a Postdoctoral Scholar in the Department of Materials Science and Engineering at the University of California, Berkeley. His research interests center around advanced complex oxide thin-film deposition, custom multidimensional and multifrequency electromechanical scanning probe spectroscopies, and machine and deep learning. Joshua earned a B.S. from the University of Illinois at Urbana-Champaign, an M.S. from the Georgia Institute of Technology and a PhD from the University of Illinois at Urbana Champaign all in the field of Materials Science and Engineering. His work has been published and highlighted in a range of high impact journals across scientific disciplines including: Nature Materials, Advanced Materials, ACS Nano, Physical Review Letters, etc.