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STATEMENT OF PURPOSE:

Three-dimensional models can provide quantitative geometric insights into questions that span a wide range of disciplines, ranging from materials science to paleontology. Today, reconstructions often are produced using x-ray scanning methods that enable researchers to quickly and nondestructively acquire three-dimensional data. Unfortunately, samples that lack strong density contrasts are poor candidates for traditional x-ray scanning techniques. In such cases, it may be advisable to utilize serial grinding — a technique in which the face of a sample is incrementally ground and then traced. For the last hundred years, however, serial grinding has been regarded as a specialized, expensive and time-consuming option. Here, we present results from the Grinding, Imaging, Reconstruction Instrument (GIRI) at Princeton University, which consists of an automated serial grinding and imaging procedure, in conjunction with a neural network image classification technique. Although the process is destructive, GIRI produces an extremely high resolution digital archive for further analysis. Furthermore, the image processing technique, which comprises a neural network that utilizes training data provided by a human researcher, can quickly and accurately trace objects of interest for three-dimensional reconstruction and analysis. To date, GIRI has been used to answer a wide variety of scientific questions, from contextualizing the role of Cloudina — one of the first organisms to make its own shell — in ancient reefs to describing the crystal textures in a fossilized magma chamber. GIRI provides an opportunity for researchers to peer into and study worlds that were, until very recently, otherwise invisible.

DESCRIPTION OF DATA SETS:

The data sets used in my proposed presentation consist of: 1) Synthetic computational geometry. These data were produce by me for the purpose of illustrating measurement errors associated with stereology. 2) Image stacks of samples created using the Grinding, Imaging, and Reconstruction instrument at Princeton University. These high resolution (80 megapixel), large (~1TB each) data sets are used to reconstruct features embedded within rocks.