Faculty of Engineering
Summer Research Program 2021-2022

Project Title: Differential measurement of 3D morphology for nanoparticles

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Objective
Using new electron microscope imaging modalities afforded by state-of-the-art fast electron detectors, we aim to measure the 3D shape of nano-particles from tomographic tilt-series. The traditional projection-law Radon transform of computerized tomography (CT), is rarely valid for strong electron scattering, particularly for the most sensitive form of phase contrast imaging. This project will perform calculations with an alternative reconstruction algorithm, which is instead based upon differentiation and does assume the validity of back-projection.

Project Details
On the everyday macroscale of human experience, the intrinsic properties of materials are often largely independent of size, which enables the construction of large objects such as buildings and bridges by comparison with scale-models. However, on the nanoscale, size can induce new physics. One example shown here includes the shape-induced enhancement of fields surrounding nanoscale conducting tips which, under electric bias, enables the field desorption of atoms for spectroscopic and microstructural decomposition of specimens. Another example, of importance in photonics and medicine, is the shape-induced excitation of plasmon resonances in nanoparticles such as Au nanorods.

An enthusiastic student will conduct 3D reconstructions using a differential geometry algorithm.


Prerequisites
Some programming experience (Python or Matlab or C++, etc.) is preferred, but not necessary.