In applications such as imaging proteins, one tries to determine the structure of a 3-D object based on its 2-D projections. Analogously, one can consider how to reconstruct a 2-D image based on its 1-D projections. A recent paper has shown how to solve this reconstruction problem as long as the image is asymmetrical. Drawing from some of the same techniques used in this paper, my project considers images that may have some sort of symmetry and tries to determine the symmetry. I show that while some conclusions can be drawn, some details about the symmetry of the image are impossible to determine based on only the projections of the image.

Symmetry Detection of Unknown Volumes from Projected Observations

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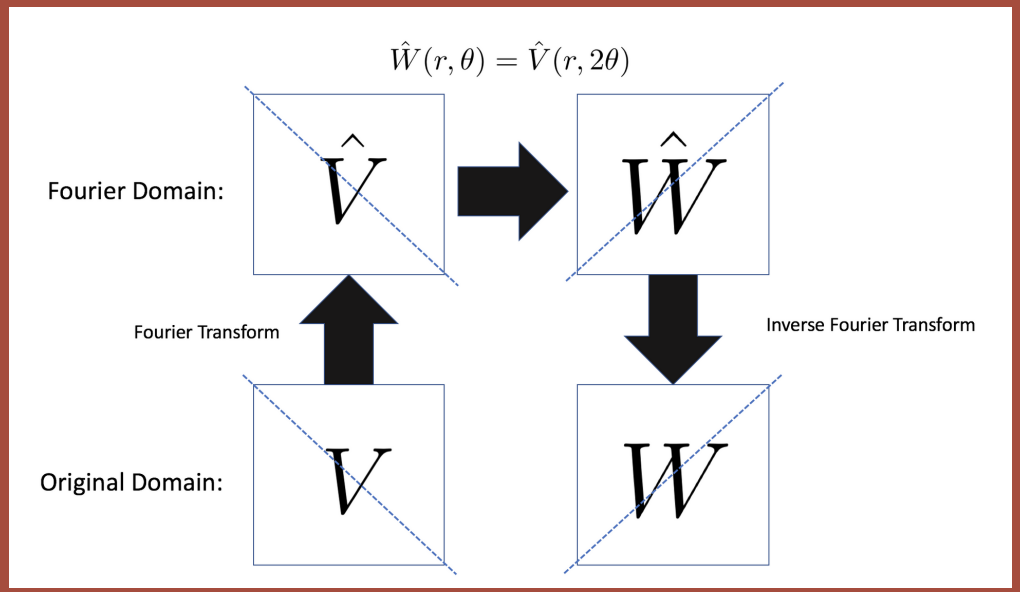
Senior Thesis



My project investigates the symmetry detection problem when only the projected measurements of a 2-D geometrical object is given using a nonlinear dimension reduction technique known as a diffusion map. In two dimensions, the group symmetry of an object can be classified as either cyclic or dihedral. Based on only the projected measurements of an image, I experimentally show it is possible to distinguish between cyclic and dihedral group symmetries. However, it turns out to be impossible to determine the order of the group symmetry. Additionally, I prove a theoretical result about how the projected measurements change in response to a change in the projection angle.

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