Compactification of the Rigid Motions Group in Image Processing

Abstract:

Image processing problems in general, particularly in the field of single-particle cryo-electron microscopy, often require considering images up to their rotations and translations. Such issues were tackled successfully for the case of rotations only, using quantities that are invariant to the action of rotations on images. However, extending these methods to cases involving translations is more complicated. This talk presents a computationally feasible and theoretically sound method of approximate invariant to the action of rotations and translations on images. Our approach allows one to reduce image processing problems to similar problems but over the sphere -- a compact domain acted on by the group of 3D rotations. We show that our invariant is induced by a family of deformed mappings, thereby compactifying the group structure of rotations and translations of the plane, i.e., the group of rigid motions, into the compact group of 3D rotations. Furthermore, we demonstrate its viability in two image processing tasks: multi-reference alignment and classification.