

Kinematic Singularities of Robot Chains

Speaker: Zijia Li

Abstract: This presentation will primarily focus on mechanism singularities and shakiness from an algebraic perspective. Kinematic singularities refer to configurations where the configuration space (c-space) is not smooth or configurations where the rank of the constraint Jacobian drops while the c-space is locally smooth. This talk investigates kinematics from an algebraic viewpoint, with a specific focus on the singularities of a variety, known as algebraic singularities. These algebraic singularities manifest as kinematic singularities or shakiness. It is demonstrated that these algebraic singularities can be attributed to properties of the ideal generated by the loop constraints — the constraint ideal. Specific scenarios arise based on whether this constraint ideal is radical. If it is not radical, a singular branch is locally defined by a primary ideal. However, primary ideals are insufficient for describing equi-singularity, such as Whitney equisingularity and Thom-Boardman equisingularity. This is illustrated with examples using integral closures of ideals. Ultimately, it remains an open question whether there exist kinematic examples demonstrating these principles.