

## **Applications of Numerical Homotopy Continuation to Mechanism Design**

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Advances in numerical homotopy solvers have augmented the engineer's ability to design mechanisms such as those used as robotic limbs. The constrained movement of mechanisms connected by revolute and prismatic joints is described by systems of polynomial equations, making numerical algebraic geometry the relevant toolset. When these equations are posed as synthesis problems, leaving mechanism dimensions as unknowns, they may easily build up to a larger system with a Bézout number greater than one million. Finding all roots to a system like this is challenging and generally avoided in practice. However, clever algorithms based in homotopy continuation have made this root finding process tractable and efficiently repeatable. These algorithms are the key component to the design exploration process used for robotic legged locomotion and other applications. Through this process, mechanisms can be designed to respond in a specified manner under certain dynamic loading conditions.