

## Cuspidal robots: geometrical analysis and issues in path planning of 6R cobots

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**Abstract:** Cuspidal serial robots can change inverse kinematic solutions (IKS) without traversing singularities, owing to their multiple IKS within a singularity-free region. This feature renders cuspidal robots unsuitable for collaborative purposes utilizing admittance control. Despite being researched for three decades, cuspidal robots are not typically considered by industries during the design phase of new robots, particularly cobots. Given the emergence of unconventional designs in 6R robots, identifying cuspidal properties during the robot design phase is crucial. The presentation will showcase recent advancements in 3R robots within the context of cuspidal robots. It will illustrate kinematic issues specific to cuspidal robots through examples of commercial robots deployed across various applications. The discussion will encompass diverse scenarios in path planning, highlighting the dependency of path feasibility and repeatability on the initial selection of IKS. Moreover, an algorithm for path planning of cuspidal robots that comprehensively addresses all cases unique to such robots will be presented. The presentation will also review established criteria for cuspidality and propose novel methods for analyzing cuspidal robots. Lastly, a brief overview of guidelines for designing noncuspidal 6R robots will be provided.