Assessing Functional Grasps: A Multi-Affordance and Optimization Approach

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Functional grasping of articulated objects remains a significant challenge in robotic manipulation, requiring precise grasp stability and trajectory alignment to enable task-specific object usage. This study presents an optimization-based evaluation framework for functional grasping, leveraging affordance prediction, point cloud processing, and grasp synthesis. We employ SpringGrasp to generate stable grasps from partial 3D point clouds, incorporating a multi-affordance alignment method to assess grasp feasibility without physical execution. Through iterative parameter optimization, we refine pre-grasp positioning based on bounding box geometry and human-inspired heuristics, improving grasp efficiency. Experimental results demonstrate a strong correlation between 2D affordance IoU and 3D Chamfer Distance, validating the robustness of our evaluation framework. Additionally, we discuss the challenges of reinforcement learning-based grasp refinement, highlighting key limitations in sim-to-real transfer and reward function design. This work provides insights into improving grasp evaluation methodologies, paving the way for more adaptive and functional robotic manipulation systems.