Path-Constrained Haptic Motion Guidance via Adaptive Phase-Based Admittance Control (Abstract Reprint)

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Abstract

Robots have surpassed humans in terms of strength and precision, yet humans retain an unparalleled ability for decision-making in the face of unpredictable disturbances. This article aims to combine the strengths of both entities within a singular task: human motion guidance under strict geometric constraints, particularly adhering to predetermined paths. To tackle this challenge, a modular haptic guidance law is proposed that takes the human-applied wrench as an input. Using an auxiliary variable called phase, the generated desired motion is guaranteed to consistently adhere to the constraint path. The guidance policy can be generalized into physically interpretable terms, adjustable either prior to initiating the task or dynamically while the task is in progress. An illustrative guidance adaptation policy is showcased that takes into account the human's manipulability. Passivity analysis is used to ensure overall system stability. Experiments, including a 20-participant user study, explore various aspects of the approach in practice.

References

Shahriari, E.; Svarny, P.; Birjandi, S. A. B.; Hoffmann, M.; and Haddadin, S. 2024. Path-Constrained Haptic Motion Guidance via Adaptive Phase-Based Admittance Control. *IEEE Transactions on Robotics*, 41: 1039–1058.