

Preface

This book explores haptic data processing methods for teleoperation systems, including prediction, compression, and error correction. In the proposed haptic data prediction method, unreliable network conditions, such as time-varying delay and packet loss, are detected by a transport layer protocol. Given the information from the transport layer, a Bayesian approach is introduced to predict position and force data in haptic teleoperation systems. Stability of the proposed method within stochastic formalism is presented based on the notion of passivity-based control. In the proposed haptic data compression method, compression techniques based on fixed rate downsampling are presented for efficient transmission over the network. Objective and psychophysical evaluations are conducted to demonstrate the compression performance of the proposed method and the adaptive downsampling method based on human perception. By presenting the two evaluation measures, the usefulness of the objective evaluation measure for haptic data is investigated. Finally, a forward error correction method is applied to haptic data over the unreliable network. Given the psychophysical evaluation results to determine the required number of bits for haptic data quantization, the error correction performance is presented under the additive noise and packet loss behavior.

Haptic Teleoperation Systems

Signal Processing Perspective

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