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Abstract

Computational Improvement in Human Dynamics Estimation †

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In the context of human–robot interaction, control of robots could be improved by adding human dynamics as a feedback to robot controllers. A computational framework for the estimation of whole-body human dynamics is provided by Nori in 2015.

The estimation procedure starts from the Newton–Euler algorithm, in which boundary conditions are replaced with measurements coming from sensors. The proposed algorithm computes an estimation of human dynamic variables, assumed as stochastic variables with Gaussian distributions, providing as a Maximum-A-Posteriori (MAP) their mean and covariance conditioned on available measurements.

In this computation, inverses of high-dimensional sparse matrices are calculated. In order to reduce the related high computational cost, Cholesky factorization is used. Clolesky factorization is a decomposition of a positive-definite matrix into the product of a lower triangular matrix and its transpose. The solution of a MAP linear system is computed by decomposing the covariance matrix with Cholesky factorization and then with forward and backward substitutions. Moreover, since the covariance matrices maintain the same structure, a permutation matrix is computed only once and then employed to each computational temporal-step to further improve the Cholesky factorization/computational performance. The computational time of the MAP algorithm decreases by about 15%.

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