MASTER'S THESIS

Analyzing human motion by sparse methods with applications to computer animation

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Analyzing Human Motion By Sparse Methods,

With Applications to Computer Animation

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ABSTRACT

Human motion plays an important role in many areas such as computer animation, film-making, game industry and computer vision. However, it is very challenging to model human motion due to its articulate and stylistic property. In this research, we propose to approach the human motion modeling by sparse methods including low-rank models and sparse coding. Our approach is novel compared to previous ones, both in the aspects of optimization models and algorithms.Our contributions to the community are as follows. Firstly, we propose the rank prior for motion completion and denoising. The resulting low-rank models are novel and effective for motion recovery. Secondly, starting from the prevailing subspace models and the low-rank models in modeling human motion, we propose sparse representation of poses for character posing. Thirdly, inspired from the success of shrinkage algorithm and proximity operator in non-smooth optimizations, we propose a fast algorithm referred to as ProPPA for solving a class of problems including basis pursuit, ℓ_1-regularized least square and low-rank matrix completion. These problems are related to the proposed models in our research. Convergence results are provided to support our algorithm and guide the implementation. Intensive experimental comparisons are reported to validate the efficiency and advantage of our algorithm over existing state-of-the-art ones. As a further contribution, we introduce the total-variation regularization to recover human motion effectively. The regularization is very useful for recovering the class of smooth low-rank matrices. The related optimization problems are efficiently solved by ProPPA. We also extend the rank prior to combine three motion priors, namely PCA, Gaussian and Sparse Representation. The resulting models obtain significant improvements over the pure low-rank models, especially when the the corruption is high. In summary, our contributions are not only in introducing new and effective models, but also their associated optimization algorithms. The models and algorithms can be extended to other areas such as image and signal processing.

Keywords: Motion capture, sparse coding, matrix completion, low-rank, human motion, computer animation

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