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M A S T E R ' S T H E S I S
for
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Unsupervised methods for clustering human whole-body actions

Problem description:

In human motion analysis, finding descriptors for an efficient recognition and interpretation of motion is an open and not deeply-investigated problem. The aim of this work will be investigating compact representations of segmented actions for an efficient recognition and symbolic manipulation. Symbolic representations of whole-body actions are of crucial importance both in understanding human motion and planning complex robotic missions at a high-level of abstraction. Only few papers investigate representations suitable for symbolic level reasoning. For example, [2] leverages Hidden Markov Models and [1] adopts SVD of human hand motion and contact forces data as well as a k-means for an increased inter-user generalization. In this work, a completely unsupervised method for action clustering will be proposed and compared with the state of the art methods in terms of: (i)recognition rate of the same actions performed by the same user, (ii) recognition rate of the same action performed by different users, (iii) capability to distinguish different but similar actions that involve the same degrees of freedom, (iv) memory required to represent an action signature. Promising starting points to find effective descriptors are matrix spectral decompositions and neural auto-encoders combined with density-based clustering such as DBSCAN.

Tasks:

- Literature research on whole body action representation and interpretation
- Development of an action representation for fully unsupervised action clustering
- Comparison with state of the art methods leveraging the HDM05 motion data base [3]

Bibliography:

[1] Alberto Cavallo and Pietro Falco. Online segmentation and classification of manipulation actions from the observation of kinetostatic data. *Human-Machine Systems, IEEE Transactions on*, 44(2):256–269, 2014.

[2] Dana Kulić, Christian Ott, Dongheui Lee, Junichi Ishikawa, and Yoshihiko Nakamura. Incremental learning of full body motion primitives and their sequencing through human motion observation. *The International Journal of Robotics Research*, page 0278364911426178, 2011.

[3] M. Müller, T. Röder, M. Clausen, B. Eberhardt, B. Krüger, and A. Weber. Documentation mocap database hdm05. Technical Report CG-2007-2, Universität Bonn, June 2007.

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