Long short-term memory network performs better in continuous estimation

April 8 2020, by Li Yuan

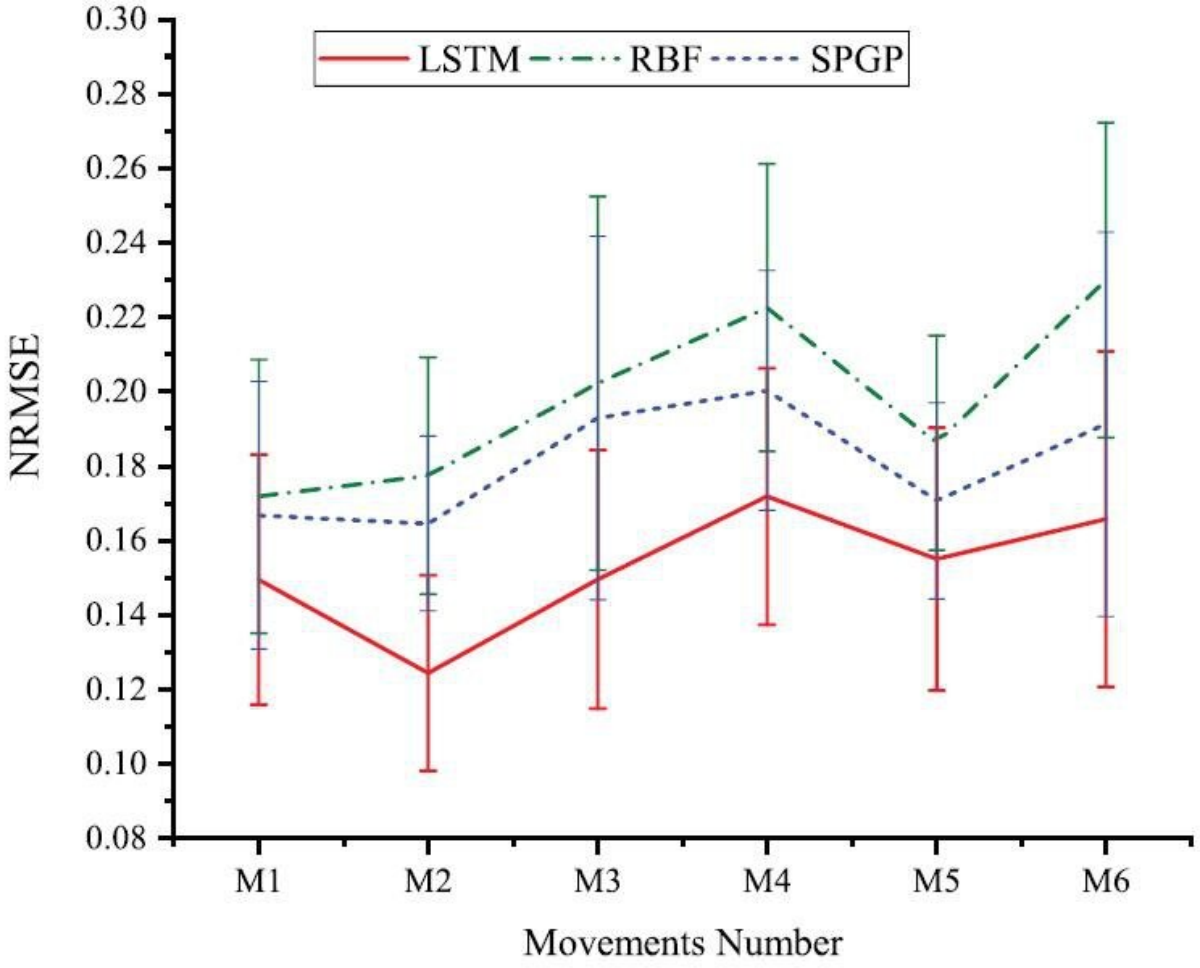

Fig.1. Summary of the NRMSE of LSTM, RBF and SPGP for 6 movements. Credit: LIN Chuang

Surface electromyography (sEMG) is a non-invasive, computer-based technique that can record electrical impulses. The present pattern-recognition-based control strategy can realize some myoelectric control, but it is not as smooth as a human hand.

Recently, researchers from the Shenzhen Institutes of Advanced Technology (SIAT) of the Chinese Academy of Sciences proposed a continuous estimation method for six daily grasp movements by the long short-term memory network (LSTM).

According to a study published in *Biomedical Signal Processing and Control*, the team designed an experiment on six daily grasp movements selected in the light of different shapes and diameters of the objects. Twenty-two sensors were spaced around a CyberGlove for recording sEMG signals.

To estimate the six grasp movements, the researchers carried out the tests through three evaluation criteria, the Pearson Correlation Coefficient (CC), the Root Mean SquareError (RMSE) and the Normalized Root Mean Square Error (NRMSE).

Then they compared LSTM with the other two algorithms, SPGP (Sparse Gaussian Processes using Pseudo-inputs) and RBF (Radial Basis Function Neural Network). The results exhibited that LSTM performed better as well as faster in all 6 movements.

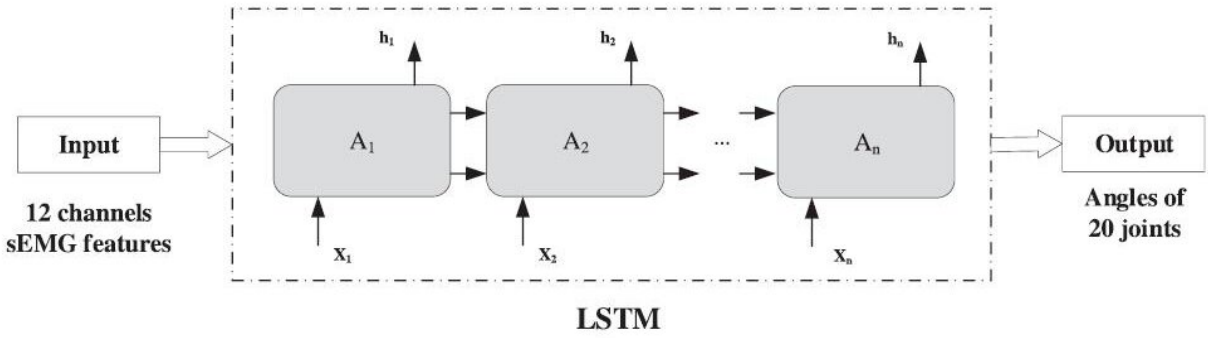

Fig. 2. The chain structure with repetitive modules of LSTM. Credit: LIN Chuang

Although in some joints, SPGP or RBF has better performance than LSTM, the statistical analysis showed that LSTM could perform better in continuous estimation of 20 finger joint angles than SPGP and RBF.

"Our results show a bright prospect of LSTM. It can be used in bioelectrical signals processing and human-machine-interaction," said Dr. LIN Chuang, corresponding author of the study. "It should be noted that the method should be personalized and optimized based on different applications."

More information: Chao Wang et al. sEMG-based continuous estimation of grasp movements by long-short term memory network, *Biomedical Signal Processing and Control* (2020). DOI: 10.1016/j.bspc.2019.101774

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