Embeeded signal processing for robot control and learning in Human-Robot Interaction

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Introduction

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Effective and intuitive human-robot interaction requires interfaces that enable individualized support by adapting to human states and intentions. Such interfaces even enable continuous learning from human. For example, exoskeletons can be used to compensate for movement disorders (1-4). Here, muscle activity recorded as electromyogram or the electroencephalogram (EEG) can be used to assist as needed (5), to infer movement intention (7) or to recognize subjective failure in assistance (8). We call our approach of biosignal analysis that is embedded into the control of a robot and uses the EEG and other biosignals embedded brain reading (6).

Methods

We apply online capable machine learning to both interpret different biosignals of the human recorded during interaction with robots and to enable adaptation to the human or learning in robots by generating feedback from inferred intentions (7), states (9), and human evaluations of the correctness of behavior using intrinsic interactive reinforcements learning (10).

Results

We can show in different application-oriented experiments that it is possible to analysis biosignals online during exoskeleton assistance in order to infer human intentions (7), states (9) and human evaluations of correctness of behavior or interaction (8, 10).

Conclusion

Our results show that the analysis of biosignals can be used to improve human-robot interaction or to enable learning and adaptation to human needs and requirements. The application of such approaches is promising to improve medical care and rehabilitation of movement disorders.

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