

Neurodynamics and Human Effectiveness

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Abstract

Air Force guidelines state that new challenges require warfighters to have flexible, game-winning capabilities that permit precise, measured responses with acceptable risk. AF strategic directions are focused on helping the information warrior think, decide, and act in new ways, on reducing decision times and improving decision quality through improved human-system interfaces and processes, and on protecting all airmen in all offensive and defensive environments. Such strategic goals can be achieved by advancing cognitive modeling, task critical information portrayal, and decision support technology.

The Computational Neurodynamics Laboratory has accumulated thorough expertise in experimental methodology of brain monitoring based on electroencephalogram (EEG) measurements. We collaborated on the development and evaluation of a novel experimental methodology to monitor cognitive activity based on scalp and intracranial recordings. The proposed mechanism of hemispheric neurodynamics-based identification of frequent cortical phase transitions opens new avenues to study human cognition, decision making, and action selection. Dynamic logic-based image-processing methodology provides the required competitive edge in challenging tasks with dynamically changing environments, having high level of noise and clutter. Our results suggest that phase structures in the human scalp EEG relating to cognition may be readily accessible with standard equipment. In particular, commercially available, non-intrusive equipment has been tested, based on high-density scalp EEG array evaluation. This approach for brain-computer interfaces has the potential of applications for various warfighter scenarios, both in training and in-flight, as well as for supporting persons with disabilities.

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