Computational implications of the muscle synergy hypothesis

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Introduction
A prominent hypothesis in motor neuroscience suggests that the central nervous system generates desired muscle activations by combining a parsimonious set of predefined primitives called synergies. Our work investigates the implications of this organization by considering the problem of controlling a simulated mechanical system in accordance with the model of time-varying synergies.

What can we learn from robotics?
In robotics synergies are synthesized (C) based on the requirements of the desired class of tasks (A). They are then used to generate appropriate control signals (B). The quality of the synthesized synergies is finally tested in terms of the obtained task performance (A).

In neuroscience the "muscle synergy hypothesis" is often evaluated by decomposing (C) a dataset of EMG signals (B) extracted during the execution of various tasks (A). Since the musculoskeletal system is non-linear, there is no guarantee that combinations of the extracted synergies lead to the observed task performance. A task-based assessment (dashed green line) is necessary.

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