ADAPTIVE CONTROL OF REACHING FOR NEUROPROSTHESIS

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Various authors proposed linear models to reconstruct monkey arm movement trajectories from neural activities. Nevertheless, I would like to reintroduce here the notion of estimating the elements of the movement outcome phase space dependent Jacobian matrix of neural activity - movement outcome nonlinear functions with a view to develop a cortical control scheme of artificial robot arms with high number of nonlinear sensors and actuators. The method uses local linearization. It is equivalent to multivariate fitting of time derivatives of time-shifted neural activities and movement outcomes (e.g. velocities if the arm movement is modeled simply as the movement of the endpoint along a movement trajectory). The fitting is performed at each and every point in movement outcome phase space. The estimated matrix elements can then be used for trajectory and velocity reconstruction even with few recording sites if consecutive movement outcomes and neural activities are reproducible. The model can also be extended to include configurations and forces. I will then present a hybrid software hardware model to illustrate how nonlinear functions can be learnt by systems whose task is to control robotic arms which have high number of sensors and actuators with correlated activities. Finally, I propose a method to calculate weight patterns, which are needed to transform high dimensional, but arbitrarily selected spatiotemporal motor outcome related activities into desired movement outcome either for a robot arm or functional electrical stimulation of primate muscles. Such weight patterns will then be ideal in a least square sense to later predict and implement desired movement even when the desired movement is known only to the primate subject. Supported by NIH.

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