**A Model of Dimensionality Reduction in Goal-Oriented Motions**

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Goal-directed arm motion paths arise as a function of the task at hand. Different tasks emphasize different goals. For example, introducing an obstacle in a reach-to-grasp action changes the resulting paths due to a shift in goal priority. In optimization, goals can be expressed in terms of cost functions. We present a geometric model that capitalizes on this fact. The model uses a gradient technique that relies on the pulled-back metric from goal space into the space of postures to resolve endpoint path selection, posture-change specification, error correction and multiple constraint satisfaction on line in a predictive manner. The resulting paths in posture space are locally geodesics of the cost surface (shortest distance paths with respect to the curvature of the cost surface). There are several advantages from using this approach: It is possible to uncover the subspace of solutions relevant to a given task and the complementary null subspace; The reduction in required degrees of freedom simplifies the dynamics problem; The basic principles can be extended to other parameter spaces; Simple neural networks easily learn this solution, and make testable predictions.

The model is instantiated in an arm with seven degrees of freedom that has to position and orient the hand in space. Some of the behavioral predictions we have tested experimentally are: (1) No effect of speed on the postural paths of the arm, (2) The initial arm posture and the target orientation affect the motion paths both in posture and in endpoint space, (3) The transport and orientation errors in the movement decrease proportionally regardless of the above manipulations in movement parameters. Simulated orientation-matching movements are compared to actual human movement data to assess the model's validity.