

Teaching Humanoids to Imitate ‘Shapes’ of Movements

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Abstract. Trajectory formation is one of the basic functions of the neuromotor controller. In particular, reaching, avoiding, controlling impacts (hitting), drawing, dancing and imitating are motion paradigms that result in formation of spatiotemporal trajectories of different degrees of complexity. Transferring some of these skills to humanoids allows us to understand how we ourselves learn, store and importantly, generalize motor behavior (to new contexts). Using the playful scenario of teaching baby humanoid iCub to ‘draw’, the essential set of transformations necessary to enable the student to ‘swiftly’ enact a teachers demonstration are investigated in this paper. A crucial feature in the proposed architecture is that, what iCub learns to imitate is not the teachers ‘end effector trajectories’ but rather their ‘shapes’. The resulting advantages are numerous. The extracted ‘Shape’ being a high level representation of the teachers movement, endows the learnt action natural invariance wrt scale, location, orientation and the end effector used in its creation (ex. it becomes possible to draw a circle on a piece of paper or run a circle in a football field based on the internal body model to which the learnt attractor is coupled). The first few scribbles generated by iCub while learning to draw primitive shapes being taught to it are presented. Finally, teaching iCub to draw opens new avenues for iCub to both gradually build its mental concepts of things (a star, house, moon, face etc) and begin to communicate with the human partner in one of the most predominant ways humans communicate i.e. by writing.

Keywords: Shape, Imitation, iCub, Passive Motion Paradigm, Catastrophe theory.