Core Concepts in Epigenetic Robotics and A Model of Infant Synchrony Detection

Christopher G. Prince
Department of Computer Science, University of Minnesota Duluth, USA
Email: chris@cprince.com

In the first part of this talk, I give our three proposed "core concepts" for the area of epigenetic robotics. These concepts are: *ongoing emergent behavior*, *ontogenetic design*, and *developmental architectures*. We propose that a main goal in epigenetic robotics is to create systems exhibiting an ongoing emergence of behavior. Like infants, epigenetic robots should adapt to the environments in which they find themselves, and in doing so they should exhibit new, emergent, behaviors and to some degree an accumulation of knowledge and skills. Ontogenetic design refers to utilizing psychological development as the task domain for designing robots and their software control architecture. Shifting focus away from task-specific design and towards the domain of psychological development is aimed at achieving ongoing emergent behavior. Developmental architecture refers to the overall organization used in constructing an epigenetic robot, and spans approaches using *specific ontogenetic design* which closely follow psychological development (e.g., of humans), and approaches using *generic ontogenetic design* which have less dependence on principles of psychological development.

I then present our experimental studies in specific ontogenetic design. Our research has focused on modeling certain infant perceptual-attentional skills, namely the detection of audio-visual synchrony. Young infants learn better in certain circumstances when provided with synchronized audio-visual signals. For example, 7-month-olds learn speech-object relations better when the object motion occurs during the speech sounds (Gogate & Bahrick, 1998, 2001). Based on an algorithm that computes Gaussian mutual information between two input channels (Hershey & Movellan, 2000), we have constructed a perceptual-level computational model that qualitatively and quantitatively detects audio-visual synchrony. We have compared the performance of this model to the skills of infants on several sets of stimuli: punctuate object motion and speech, two people making speech movements but speech-audio from only one person, and two speech-audio sources and a visual motion source (face or oscilloscope) that corresponds to one speech source. Our future research goals include an ontogenetically designed model that uses audio-visual synchrony detection to help bootstrap within modality attention.

Web site for this talk: http://www.cprince.com/PubRes/Zurich04
Project web site: http://www.cprince.com/Projects/KidCause

Papers particularly related to this talk:

http://www.cprince.com/Drafts/EpiRobCoreConcepts/Core-concepts-7-28-04.pdf
http://www.cprince.com/PubRes/JCSR04/Prince-Hollich-7-1-04.pdf

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