Evolutionary Controller Synthesis for 3-D Character Animation

Larry I. Gritz

D.Sc. Dissertation
Department of Electrical Engineering and Computer Science
The George Washington University

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Abstract:

Three dimensional computer animation has become increasingly popular over the past decade. Computer animation now has an important role in entertainment, education, and simulation. For computer animation of characters, the role of the animator has unfortunately stayed similar to that of a stop motion animator, rather than like a film director. Research in computer animation has tried to address this by giving higher levels of control to the animator, but these methods often result in lack of fine control over the animated characters. This is inadequate because fine control is essential to both aesthetics and the ability of the animator to direct a meaningful narrative.

This dissertation presents methods of articulated figure motion control which attempt to bridge the gap between high level direction and low level control of subtle motion. These methods define motion in terms of goals and ratings. The agents are dynamically-controlled robots whose behavior is determined by robotic controller programs. The controller programs for the robots are evaluated at each time step to yield torque values which drive the dynamic simulation of the motion. We use the AI technique of Genetic Programming (GP) to automatically derive control programs for the agents which achieve the goals. This type of motion specification is an alternative to key framing which allows a highly automated, learning-based approach to generation of motion. This method of motion control is very general (it can be applied to any type of motion), yet it allows for specifications of the types of specific motion which are desired for a high quality animation. We show that complex, specific, physically plausible, and aesthetically appealing motion can be generated using these methods. Both skill-based and action-based motion can be specified in this manner. We also introduce the new paradigm of key marks, a generalization of key framing which is not subject to many of the limitations of key framing.

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Author contact:

lg@pixar.com

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