Control of Complex, Physically Simulated Robot Groups

David C. Brogan
University of Virginia
Charlottesville, Virginia

November 14, 2006

Abstract

Actuated systems such as robots take many forms and sizes but each requires solving the difficult task of utilizing available control inputs to accomplish desired system performance. Coordinated groups of robots provide the opportunity to accomplish more complex tasks, to adapt to changing environmental conditions, and to survive individual failures. Similarly, groups of simulated robots, represented as graphical characters, can test the design of experimental scenarios and provide autonomous interactive counterparts for video games. The complexity of writing control algorithms for these groups currently hinders their use. A combination of biologically inspired heuristics, search strategies, and optimization techniques serve to reduce the complexity of controlling these real and simulated characters and to provide computationally feasible solutions.

Keywords: Multiagent, dynamic simulation, group navigation, herds, swarms

Appendix A. Tables

Table 1: The distance from the center of mass of each link to the distal and proximal joints in x, y , and z . A positive distance along the y axis refers to a location on the left side of the body; a negative distance refers to the right side. The z axis is vertical and the x axis is positive in the direction that the model is facing.

Link	COM to Proximal $(x, y, z$ m)			COM to Distal $(x, y, z$ m)		
Torso to neck				0.012	0.0	0.32
Torso to waist				0.012	0.0	-0.32
Head	-0.009	0.0	-0.064			

Table 2: Human model's rigid-body parameters. The moments of inertia are computed about each link's COM

Link	Density (g/cm^3	Mass (kg)	Moment of Inertia $(x, y, z$ kgm^2)		
Head	1.17	5.89	0.030	0.033	0.023
Torso	1.01	29.27	0.73	0.63	0.32
Upper Leg	1.04	8.35	0.15	0.16	0.025