CS775 Paper Abstract : Locomotion Skills for Simulated Quadrupeds

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March 21, 2014

1 Introduction

In this paper [2], the authors have tried to solve the problem of modelling various sets of motions and gaits of a quadruped. Various actions that the authors tried to simulate were simple walk, trot, pace, canter, gallop, jumps over obstacles, falls and recovery after falls, sitting, lying down, getting up.

This problem has direct applications in gaming industry, in robotics (Boston Dynamics's Wildcat [3]) and in movies (The Chronicles of Narnia). Due to these widespread applications, finding a method to create a simulation that is as close to real life as possible becomes necessary.

2 Problem Scope

We will try to create a simulation for a dog which can go through various motions and gaits. We will first try to implement the 6 basic gaits including simple walk, trot, pace, canter, transverse gallop and rotary gallop. After modelling this, we will try to optimize these motions to match closely to the data from the filmed dog. After doing this part, if time permits, we will model the other motions of the quadruped like jumps over obstacles, falls and recovery after falls, sitting, lying down and getting up.

We will create the model for dog and the surface in OpenGL. We will code everything else in C++ and use Open Dynamics Engine(ODE) library for forward dynamic simulator.

3 Solution

The simulation [1] is done as follows:

1. The motions and gaits of the simulated quadruped (a simulation for dog is used for demonstration) is controlled by various controllers. The controllers include dual leg frames(which are capable of motion independent of each other), a flexible spine (abstracted by joined links) and internal virtual forces.

2. By changing the aforementioned controllers, torques are computed. These torques are then passed to the forward dynamic simulator at each time step. The authors have considered the forward dynamic simulator as a black box and used the Open Dynamics Engine(ODE) for it.

3. To set the controllers, gait graphs are used. Gait graphs are plots detecting the swing phase of controllers against the current time. The authors have used experimental data from filmed video of a dog and from data provided by Alexander [4] to generate gait graphs for the motions and gaits of the simulated dog.

References

[1] S. Coros, A. Karpathy, B. Jones, L. Reveret, and M. van de Panne. Locomotion Skills for Simulated Quadrupeds, Video. `https://www.youtube.com/watch?v=dRthdBr46cs`. [Online; uploaded 09-May-2011].

[2] S. Coros, A. Karpathy, B. Jones, L. Reveret, and M. van de Panne. Locomotion skills for simulated quadrupeds. *ACM Transactions on Graphics*, 30(4):59:1–59:12, July, 2011.

[3] B. Dynamics. Introducing Wildcat. `https://www.youtube.com/watch?v=wE3fmFTtP9g#t=46`. [Online; uploaded 03-October-2013].

[4] A. R. The gaits of bipedal and quadrupedal animals. *The International Journal of Robotics Research*, 3(2):49–59, 1984.