Department of Electrical Engineering and Computer Science
Massachusetts Institute of Technology

6.894 Legged Locomotion in Robots and Animals

Problem Set 6

Problem 1

1.1 Implement a Matsuoka oscillator on page 100 of Taga (reprinted below). Use whatever language you wish (Matlab, C, Java, etc...). Matlab's ode (ordinary differential equations) function and graphing routines are probably the quickest to use.

$$\tau_i \dot{u}_i = -u_i - \beta f(v_i) + \sum_{j \neq i} w_{ij} f(u_j) + u_0 \tag{1}$$

$$\tau_i' \dot{v}_i = -v_i + f(u_i) \tag{2}$$

$$(f(u) = max(0, u)), (i = 1, 2) \tag{3}$$

$$y_{out} = f(u_2) - f(u_1) \tag{4}$$

(Yes, there is a typo on page 100. Second equation should be $\tau_i' \dot{v}_i = ...$ not $\dot{\tau}_i \dot{v}_i = ...$). max(0,u) is simply the maximum between 0 and u. In other words if u is positive then max(0,u) is u. If u is negative then max(0,u) is 0.

Start with Taga's parameters: $\beta = 2.5$, $u_0 = 6.0$, $\tau_i = \frac{1}{32}$, $\tau_i' = \frac{1}{2.656}$, $w_{12} = w_{21} = -2.0$. Play with the parameters to get a feel for what they do. Briefly describe how each parameter affects the oscillator. Drawing a block diagram of what the equations are doing might help.
1.2 Implement another oscillator with a slightly different frequency than the one in 1.1. Have both run and see that they run at different frequencies. Now connect the two oscillators (use a weight w_{ij} between them) and get them to entrain. Play with the weights between the oscillators and the parameters of the oscillators. See that for some parameters the oscillators entrain and for others they don't.

Hand in your code and a short, concise (less than two pages) writeup on what you did.
1.3 (Extra) Implement various rings or trees of oscillators. See if you can get something that "looks" like quadrupedal gaits or lamprey travelling waves, etc.

Problem 2

One page project proposal. Have ready for discussion next week (Tuesday October 26) but not due till Friday October 29th. Either submit in class on Tuesday, by email (jpratt@ai.mit.edu), or bring to NE43-006.