# Math 485-002 MATLAB Exercise

klin@math.arizona.edu

February 5, 2008

If we move the fulcrum of a pendulum up and down in a rhythmic way, for example by attaching it to a motor, the resulting system is called a *periodically driven pendulum*. The periodically driven pendulum obeys the equations

$$\frac{d\Theta}{d\tau} = \Lambda \tag{1}$$

$$\frac{d\Lambda}{d\tau} = -\sin(\Theta(\tau)) - \alpha\Lambda - \beta\cos(\omega\tau)\sin(\Theta(\tau)) \; . \tag{2}$$

There are now two more dimensionless parameters, $\beta$ and $\omega$, describing the amplitude and frequency of the fulcrum's movement.

**Exercise 1.** Modify the program 'pend.m' we wrote earlier to solve the equations above.

**Exercise 2.** Try $\alpha = 0$, $\beta = 20.4020$, $\omega = 10.1$, and solve the equations over the time interval $[0, 40]$ with initial conditions $[\pi, 0.1]$. Plot the first component, $\Theta$, as a function of time, $\tau$. What do you see? What is the physical meaning of that solution? Can you explain why the pendulum is doing this?