Lecture 4:

Introduction to discrete-time dynamics & the logistic map

COSMOS - Making Robots and
Making Robots *Intelligent*

Tools: Plotting Iterated Maps and Stability Analysis

First example: $x_{k+1} = \cos(x_k)$

Who cares?

Saw that *x = 0.739…* is a ***stable fixed point***

Cruise control response for $k = 0, 1, 2, \ldots$

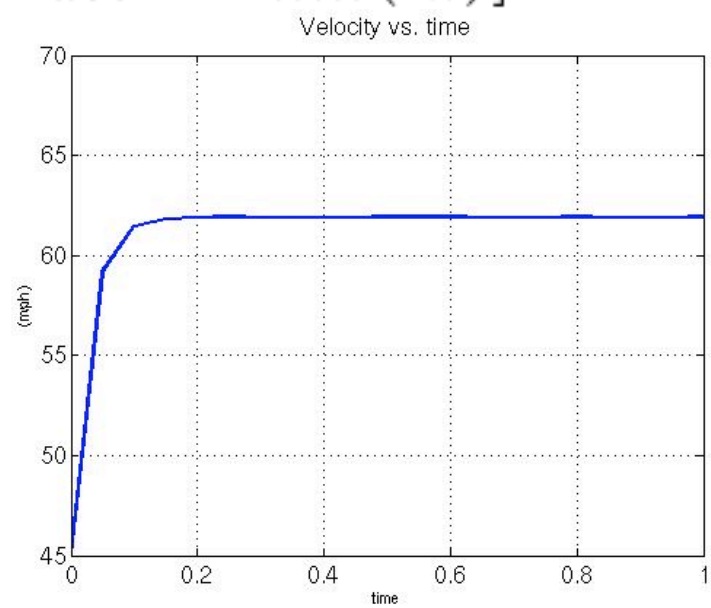
$$v_{k+1} = v_k + \frac{\Delta}{m}[-(b+K)v_k + Kv_{des} + u_{hill}(t_k)]$$

Plot velocity versus time

$$t_k = k * \Delta$$

Starts at 45mph, want 60mph in presence of random noise

$$\Delta = 0.05, \ m = 5$$
$$b = 1, \ K = 20$$



A *Critical* Piece of the Puzzle - **The Model**

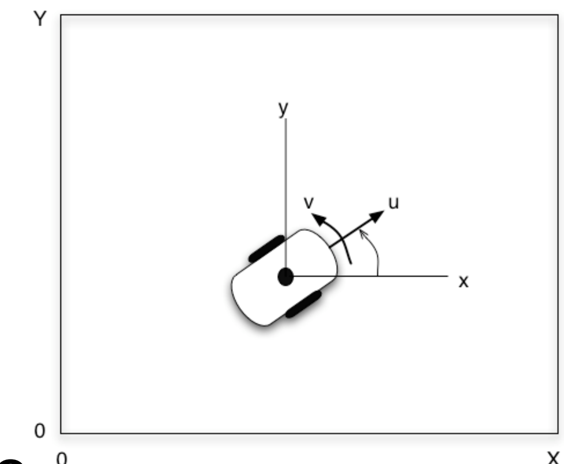
General expression:

$$x_{k+1} = f(x_k)$$

"Bobs" response:

$$v_{k+1} = v_k + \frac{\Delta}{m}[-(b+K)v_k + Kv_{des} + u_{hill}(t_k)]$$

Robobrian Model:



$$x_{k+1} = x_k + \Delta u_k \cos(\theta_k)$$

$$y_{k+1} = y_k + \Delta u_k \sin(\theta_k)$$

$$\theta_{k+1} = \theta_k + \Delta v_k$$

Stability: Will ***Robobrain*** do what we want?

Yes, if feedback control (*u,v)* designed properly.

Logistic Map - An Example of ***Chaos***

$$x_{k+1} = r x_k (1 - x_k)$$