Lecture 5:
Introduction to Modeling

COSMOS - Making Robots and
Making Robots *Intelligent*

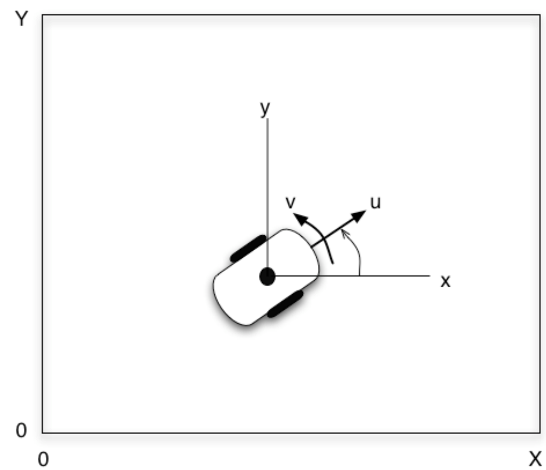
The Model Allows Response Prediction

Given a **starting condition**, and a **model**
(*think - iterated map ~ discrete-time dynamics*)
we can **predict** what our robot will do.
==> Prediction reliable in short term.

"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: Design control (*u,v*) so *(x,y,θ)* acheive desired values.

Next Step - Choice of Feedback Control

Model of "*Bob*":

$$mv_{k+1} = mv_k + \Delta[-bv_k + u_{eng} + u_{hill}]$$

Control:

$$u_{eng} = K(v_{des} - v_k), \quad K > 0$$

Steady-state (when $v_k = v_{ss}, \; k = 0, 1, 2, \ldots$):

$$\Longrightarrow v_{ss} = \underbrace{\frac{K}{b+K}}_{\text{Goes to 1 as } K \to \infty} v_{des} + \underbrace{\frac{1}{b+K}}_{\text{Goes to 0 as } K \to \infty} u_{hill}$$

Goes to 1 as $K \to \infty$

Goes to 0 as $K \to \infty$

Why this choice for control? How do we choose (*u*,*v*) for Robobrain? ==> Key form is feedback error signal: $(x, y, \theta) - (x_{des}, y_{des}, \theta_{des})$

Objective

- Understanding of Modeling using Iterated Maps

- Using Matlab for Prediction using Model.
Predator-Prey System Example.

- Robobrain Model and Control Objectives.