

Lecture 3:  
***Introduction to  
discrete-time dynamics***

COSMOS - Making Robots and  
Making Robots *Intelligent*



# A Definition of Dynamics

***Dynamics*** - mathematical description of the evolution in time of the behavior/response of any system, be it mechanical, electrical, chemical, biological, or a combination of these, to external and internal influences.

Examples: differential equations (ordinary or partial), difference equations, transfer functions.

# Model of Bob - Discrete Time Dynamics

General expression:

$$x_{n+1} = f(x_n) \quad \text{for example } f(x) = \cos(x)$$

Again,  $n$  is the counter for time



“Bobs” response for  $k = 0, 1, 2, \dots$  given some  $v_0$

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

The Stability question: How does velocity behave near the desired steady-state value? Is it **stable**, or **unstable**

That is - does it stay near / converge, or does it diverge?

# Objective

- Continue with Matlab function commands.
- Creating Matlab function files.
- Plotting output response of dynamic model.