University of Anbar Engineering College Department of Mechanical Engineering



#### **ME 4309 - Engineering Control and Measurements**

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#### **Fourth Stage**

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## Chapter 2: Modelling of Dynamical Systems

- Real systems are complicated
- We want to work with simple models
- We need to make some assumptions in our models

# Modelling of Dynamical Systems

# What type of model?

- Physical
- Thought
- Mathematical
  - -Universal language
  - -Easy to change time scales
  - -Easy to try 'what if'
  - Can use parameters not possible in reality

# **Modelling Assumptions**

- Real systems are complicated
- We want to work with simple models
- We need to make some assumptions in our models



Distributed parameter



#### High Order



n<sup>th</sup> Order equation



Simple Model – 12<sup>th</sup> Order Moderate Model – 24<sup>th</sup> Order 'Accurate' Model – infinite Order

Multiple Input – Multiple Output



Inputs – 6 thrusters Output – X,Y,Z, $R_x$ , $R_y$ , $R_z$ 

• Time varying



Behaviour changes over time due to wear etc

### Simplifications

• Linearity

$$y_1 = f(x_1)$$
$$y_2 = f(x_2)$$

 $y_1 + y_2 = f(x_1 + x_2)$ 

### Simplifications

Lumped parameter Video Ray



#### Low order

### Simplifications

- Single input single output – Ignore interactions
- Time invariant

## Think!

- Think of a system which needs control
  - What are the outputs?
  - What are the inputs?
  - What are the interactions?