Modelling of Automotive Systems

509H3

Dr. W.J.Wang

Introduction

- An introduction to modelling techniques in the automotive sector
- An opportunity to revise Matlab and to develop an understanding of Simulink
- For some a revision of principles
- Two projects in the assessment
  1. Vehicle Modelling for fuel consumption using QSS
  2. Vehicle Lateral Dynamics and Steering Control using Matlab (SIMULINK)

Learning Outcomes

Aims

To provide students with a system concept of an automotive vehicle, an introduction to how these systems can be modelled, and the uses of such models.

Objectives

Students should have an overall understanding of the systems that make up a typical automotive vehicle, and the different types of model that might be employed to represent them. They should be aware of tools used in automotive modelling and have some practical experience in at least one area.

Contents

- Introduction
- Dynamics fundamentals
- Vehicle Longitudinal Dynamics
- Vehicle Lateral Dynamics
- Vehicle Tyre Dynamics

Assessment

Project Report	Spring Term Week 8 Thu 16:00	40.00%
Project Report	Spring Term Week 10 Thu 16:00	60.00%

Level M - 15 credits

Week 1 – Week 9

3 hours / week , 2 hours or so talk, 1 hour DIY for project and question time.

Week 10

Project catch-up

Course Materials

www.sussex.ac.uk/~tafb8/mas/mas.html

Reading List

Gillespie, Thomas D. Fundamentals of Vehicle Dynamics, 1992

Guzzella, Lino and Sciarretta, Antonio, Vehicle Propulsion Systems, 2005

Guzzella, Lino and Onder, Christopher Introduction to Modeling and Control of Internal Combustion Engine Systems, 2004

Rajamani, Rajesh, Vehicle Dynamics and Control, 2005

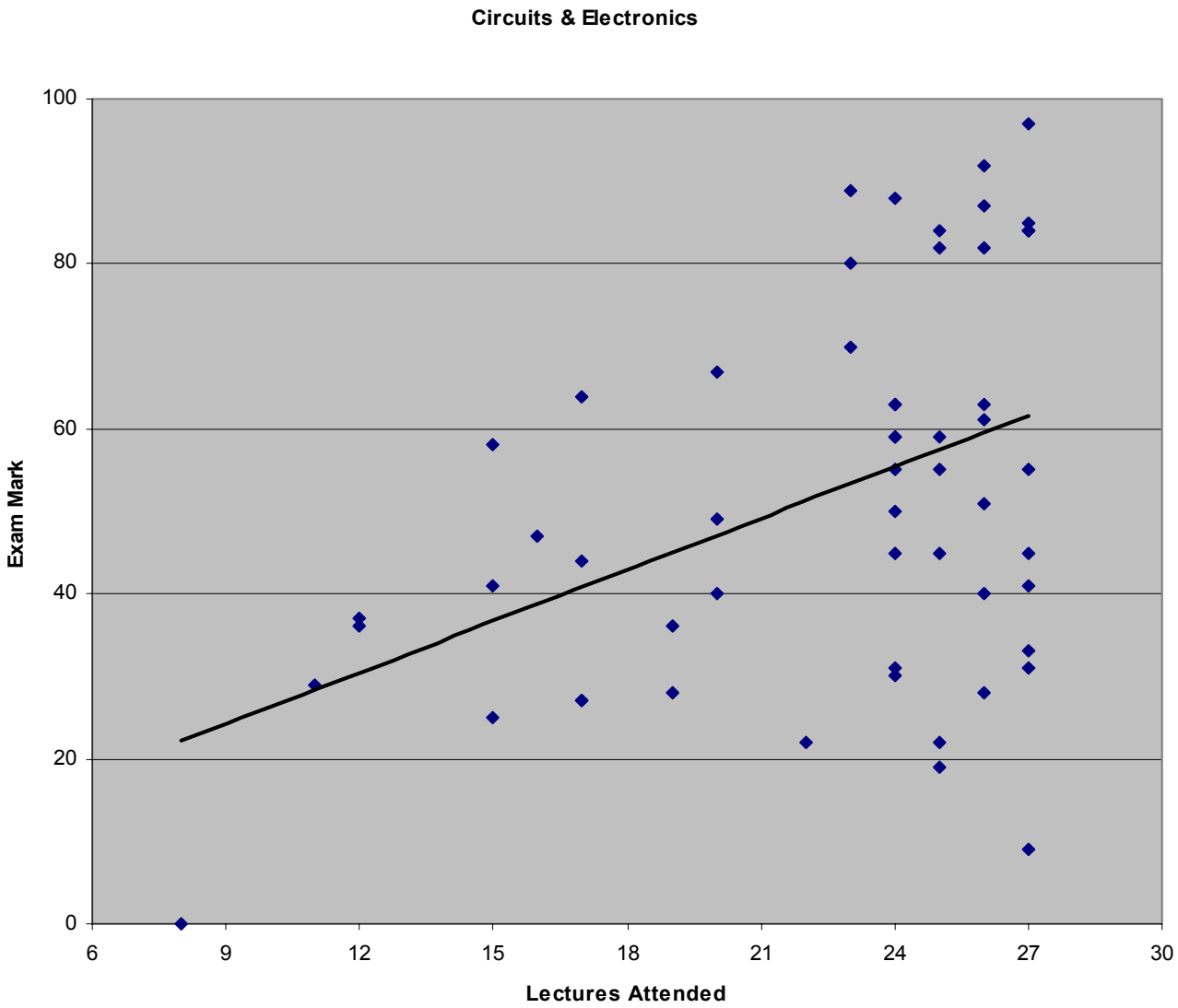
Friedland B. Advanced Control Systems Design, Prentice Hall, 1995.

Friedland B. Control System Design. An Introduction to State Space Methods, McGraw Hill, 1980.

Brogun W. Modern Control Theory, Prentice Hall, 1991.

Heisler H. Advanced Engine Technology, Arnold, 1995.

Bosch R. Automotive Handbook, 1996.



By Denis Edwards

Modelling

- The implementation of a representation of a system
- Usually computer based
  - Uses codes like Matlab
  - Simulink makes the modelling process easier
- Uses physical laws with some experimental support
- Is not fully credible until validated

Structure of a model

- Inputs
  - Flow, torque
- Outputs
  - Speed, flow, power
- Storage
  - Inertia
- Energy conversion
- Measurements
- Disturbances

Key steps in model formulation

- Identify the system boundaries
  - Input and output
- Identify storage
  - And the level variables (how much is stored)
- Form equations that express the flows between stores as a function of the level variables
- Identify unknown parameters with experiments
- Validate using experiments

Considering timescales

- Controlled variable sets the timescale of the system
- Fast variables we consider algebraic
  - The response of an instrument
- Slow variables we consider as constant
  - Ambient conditions, bulk properties (like water temperature)