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Massey University

Robotics for Engineering Education

School of Engineering and Advanced Technology
Massey University

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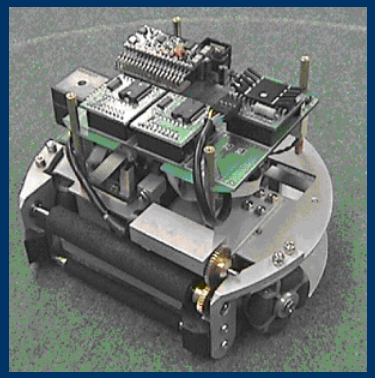
School of Engineering & Advanced Technology

Outline

- Introduction – some observation and thoughts
- Product – a key to open the door for a wonderful engineering world
- Some Examples of engineering teaching practice

Introduction

- Most products are the integration of modules from different engineering areas – mechanical, electrical and electronics, computing etc.



- Engineering graduates are expected to design, manufacture and control those products, and specifically they should be competent in
  - Mechanical design … *parts* and *mechanism*
  - Circuit design … *digital* and *analogue*
  - Controller design … *classical* and *modern*
  - Computer programming … *low* and *high levels*
  - Man-machine engineering design
  - Integration of different engineering modules

  ……

Are current education models suitable for producing such versatile graduates ?

Mechatronic major is designed as one of the responses to this question.

Some issues in common teaching practices:

- Simple addition:

  Mech. Eng. + Elect. Eng, Theory + Hands-on

- Imbalance in allocation of teaching contents
  - ➢ Dominated by either mechanical, electrical or electronic engineering.
  - ➢ In mechanical engineering,
    - • **more** on mechanics/materials, **less** on mechanism
  - ➢In electrical/electronic engineering
    - • **more** on digital circuit , **less** on analogue circuit
    - • **more** on low power circuit, **less** on high power circuit
    - • **more** on low frequency , **less** on high frequency
    - • **more** on microcontroller, **less** on application specific circuits of logic gates or flip-flops
  - ➢**More** on computer aided design tools, **less** on fundamentals

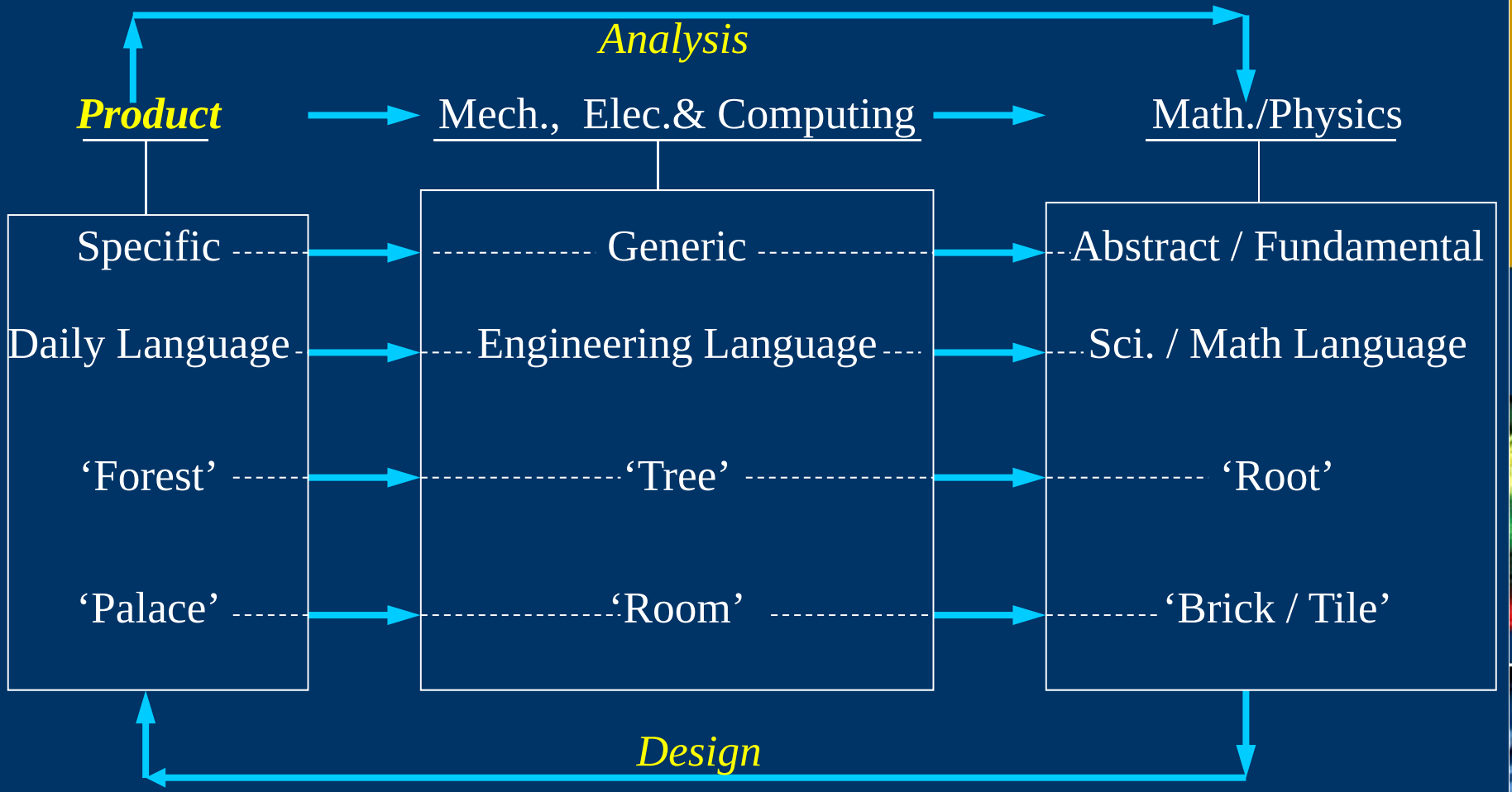
- ➢**More** on computer intelligence, **less** on mechanical intelligence
- ➢**More/first** on individual topic (“trees”, “building blocks”), **less/later** on a whole system (“forest”, “house”)

- Labs are full of computers, but lack real engineering gears
- Research and teaching is detached
- Engineering teaching or science teaching ?
- Knowledge perceived by the students is piecewise, and its relevance to their lives in real world is fuzzy
- A generic impression is that engineering courses are hard and “dry” , against other so called “soft” courses look more appealing

If people can enjoy many new experiences brought by engineering *products, why cannot they find the same enjoyment from* engineering *education ?*

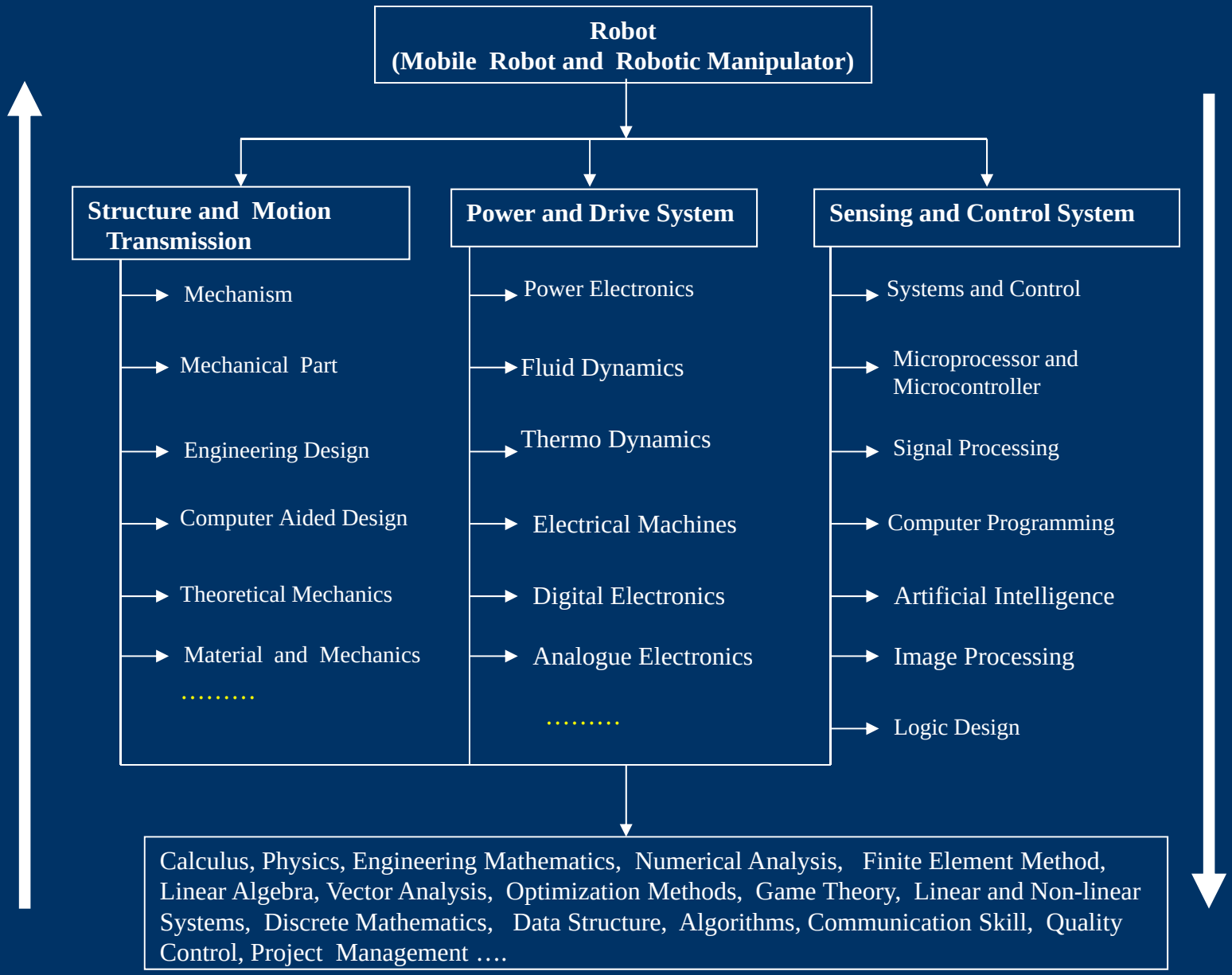
How about link products to the teaching from the very beginning of students’ learning journey?

Product – a key to open the door of a wonderful engineering world



Product **-** a stimulus (frequency rich 'delta' function) to trigger all the good elements and processes of engineering teaching

Take robotics as an example



Examples

- ***RoboCar*** (design, fabrication, report, competition and blogs; budget controlled)

Racing

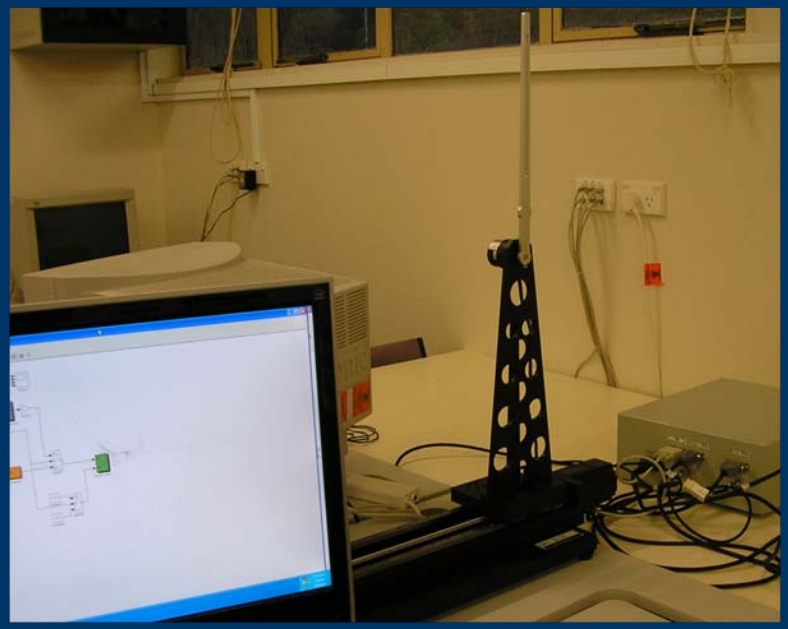
Maze Navigation/Line Following

Hill Climbing

Happy students

- ***Mousetrap Car*** (design, fabrication, CAD, competition and report; recyclable materials used)

- ***Inverted Pendulum -Pole Balancing Robot*** (analysis, real time control design, report, and demonstration)



Inverted Pendulum

- ***Robotic manipulator and production line*** (analysis, control design, programming, report and demonstration)

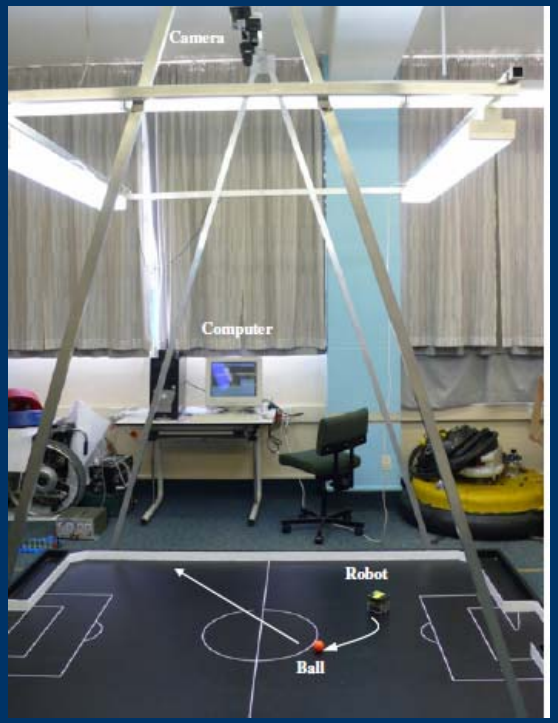
Robotic Arm

MPS System

- ***Twin_rotor MIMO System – Flying Robot*** (analysis, MIMOcontrol design, Real time system, report and demonstration)

Twin-Rotor MIMO System Control

- ***Robotic Soccer System*** (mobile robot motion control, real time programming, assignment)



GUI

Mobile robot tracking a target

Conclusions

- Robotics is a very good platform for engineering teaching
- It stimulates students' interest in engineering and equips them with
  - rigorousness in theoretical foundation
  - solidness and extensiveness in knowledge base
  - versatility in hands-on
  - employability upon graduation
  - potential for future development