

## **UNLV ME 425/625 – Robotics**

Introduction and Course Philosophy

# Paul Oh: Background



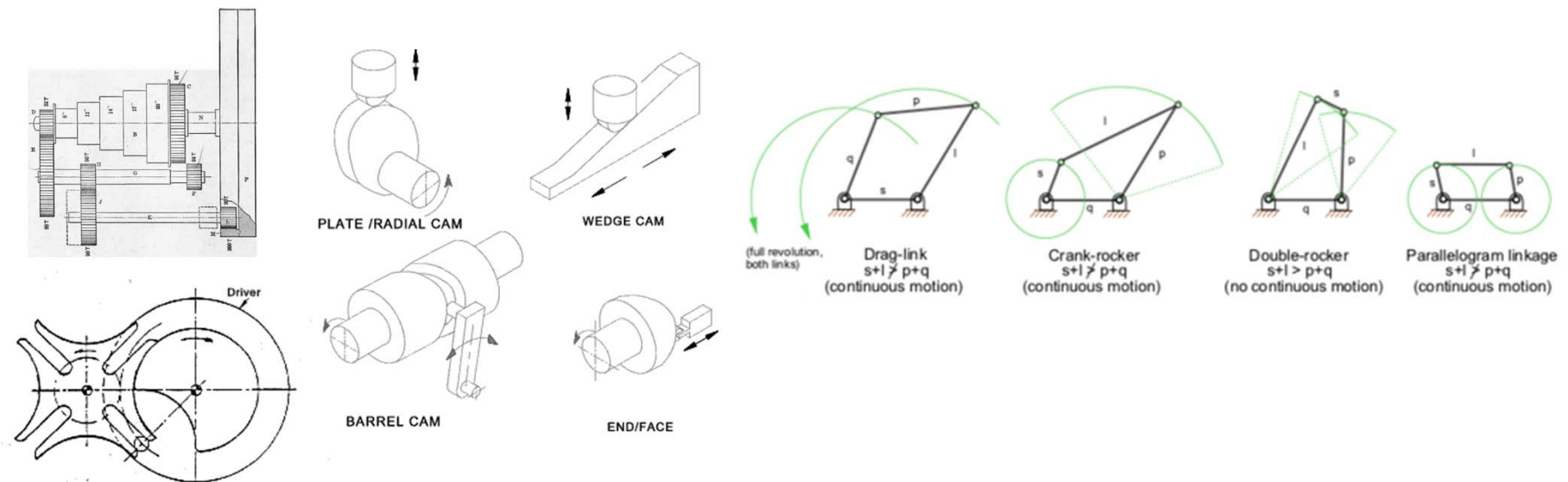
- 2000-2014 Drexel + 2014-today UNLV
- Advisor: ASME 15-years
- SD teams and multiple awards
- \$13M+ in research/design funds
- 150+ Journals, 3 Books, Proceedings
- Drones and Autonomous Systems Lab
- NASA, ONR, Boeing Fellow
- NSF Robotics Program Director (2008-2010)

Enjoy creating courses where labs  
reinforce theory

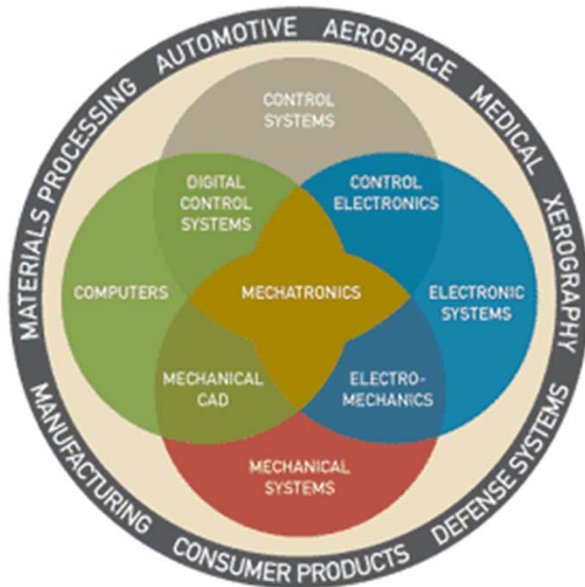
# Motivation for UNLV Robotics Course Sequence

## More Background:

- **Need 1:** Mechanism design is fundamental but poorly addressed at UNLV  
Evidence: Senior Design projects, lack of courses, competitions
- **Need 2:** Lack of Masters- and senior-level courses at UNLV  
Evidence: few course options
- **Gap 1:** Mechatronics – taught from point-of-view rather than holistic approach  
EE: limited coverage of mechanical aspects (e.g. force, torque, gears)  
ME: heavy focus on electronics and embedded micros
- **Resources:** Mathematical theory versus Experiential discovery  
Robotics is essentially a collection of “best practices” that should be experienced



# My “Issues” with Robotics Courses



## Issue 1: Frankenstein Approach

- Ad-hoc: Pieces are slapped together
- One-offs: Hard to reproduce and rarely robust

## Issue 2: Lack of Constraints

- If exists, typically only on footprint (SWAP)
- Economics of design are rarely addressed

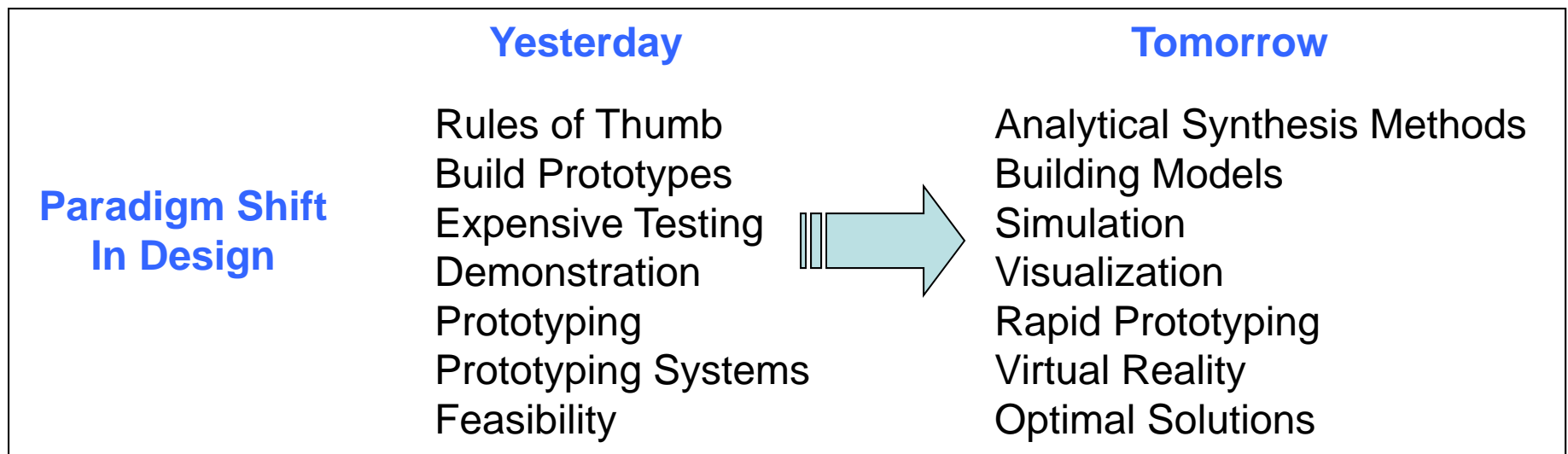
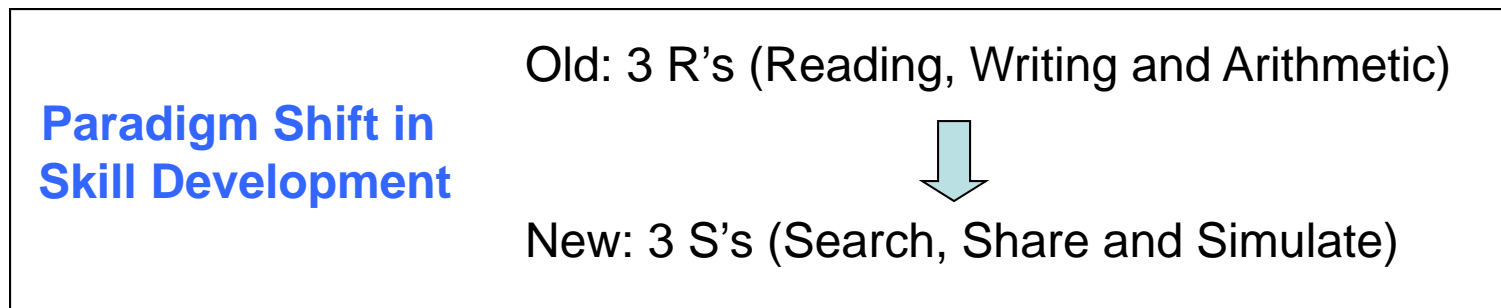
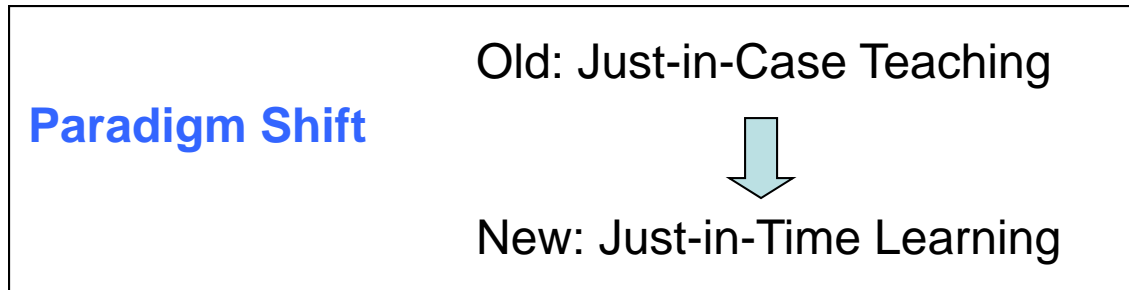
## Issue 3: Software tools rarely used in such courses

- CAD rarely ever discussed or used for prototyping
- Simulation rarely used for testing and evaluation

## Issue 4: Books lack

- All very similar: focus on basic circuits or force/torque
- Projects difficult to reproduce

# Paradigm Shifts in Teaching, Learning and Design



## Lessons from ME 425 (2014-2022)

- 1st half: mechanisms; 2<sup>nd</sup> half: robot sensing, actuation, communication, interfacing
- Project 1: Automata; Project 2: H-bridges
- Ethics with weekly YouTube videos and short discussion and Team Debates
- Strong Course Evaluation scores (weekly Hands-on Labs)... but student issues with:
  - Programming (“Professor assumes students will learn the code”)
  - 1<sup>st</sup> and 2<sup>nd</sup> halves somewhat disconnected

### Evolving ME 425: Trinity Firefighting Robot Competition?



<https://www.youtube.com/watch?v=wSeZ1mXdpho>

- Course content differences: ME (kinematics, dynamics and control), ECE (embedded micros), and CS (**path planning**)
- Competitions: **Hacking** versus Systems Engineering?

# Challenges to implement TFFC in ME 425

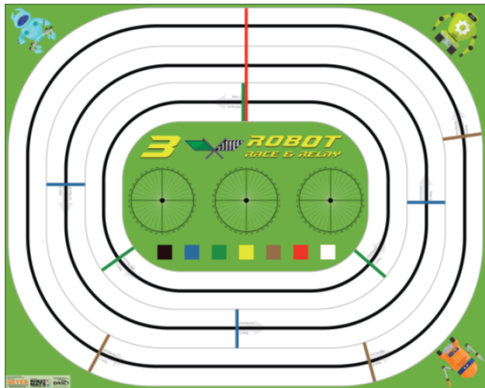
Making TFFC more ME-centric?

- A. 2<sup>nd</sup> story fire? Mechanisms to elevate extinguisher
- B. Mechanisms to extinguish without blowing air e.g. water

Obstacles to implementing TFFC in ME 425

- C. Perception and Sensor Fusion: e.g. thermal cameras
- D. Maze solutions

## Building Towards a Future ME 425



### Project 1 – Relay Race

Mechanisms for baton exchange  
[https://www.youtube.com/watch?v=6Z3DM4\\_cSBI](https://www.youtube.com/watch?v=6Z3DM4_cSBI)



### Project 2 – In Development

Wall-Following (mazes) and Photovore  
<https://www.youtube.com/watch?v=PjCPrv4uhOo>  
<https://www.youtube.com/watch?v=z3i5J8ak4f0>

## Next Steps

- Pick up NXT Kit
- Propose: Lecture/Lab: Every Monday **18:00-21:00** (1325 E. Flamingo Rd)
  - Is **16:00 or 17:00** an option (so we can end earlier)?
- Bring Laptop and NXT Kit to every class

