

METR3800

MECHATRONICS TEAM PROJECT 2

Paul Pounds
26 February 2013

In the year of our lord, 1498...

In this year of our Lord, 1498, Her Royal Highness, Isabella Queen of Castile and Leon, Queen Consort of Aragon, Majorca, Naples and Valencia, bids you assemble a fleet and set sail at once for the new lands recently discovered by the realm's foremost explorers. There, you are to claim its valuable and verdant expanse for Castile, and its precious resources for the Crown.

You are instructed forthwith to construct a number of worthy sea vessels with which to conduct the expedition. Her Highness has graciously granted you funds from the treasury sufficient to commission three ships suited to the task, as well as provisions for five months at sea. She is most adamant that you do not exceed her generosity.

To aid you in this duty, the court cartographer has prepared a map of the ocean and coastline you will be traversing. Likewise, the court astrologer has provided you with a celestial chart of the stars in the heavens above the new lands. With these, you will be able to cross the seas and navigate the coast until you reach lush and productive farmlands to seize.

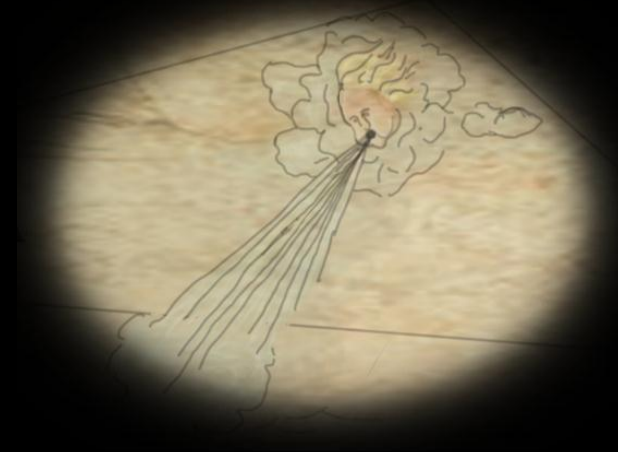
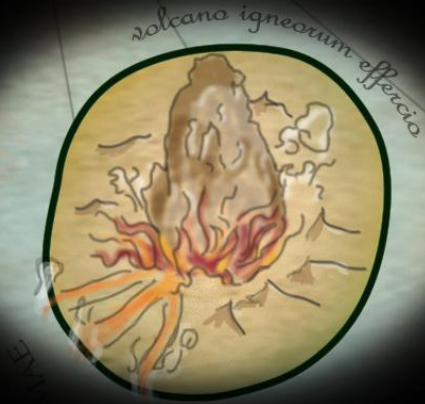


Isabella





MISERIA ANG



Magna atque horrenda deus rex Axolotlzuma.
Ingentem oculorum et stridor dentium devorabit
omnia qui audent intrare ima. Nemo qui descendunt
in eius crypta, unquam revertor. Latebras fetae
dispersus est cum
mille cadauera.

Solum vere
ingeniosi possunt
assumere thesaurum.
Solum vere stultus
conarentur eam.
Axolotlzuma erit
contrucidant omnibus
vobis. Eam amens est
ad considerandum in



Voyage to the New World

METR3800

Mechatronics Team Project 2

2013

Treasure of Axolotlsuma



METR3800

- **What:** Mechatronics team project course
- **When:** Starting now, going until week 13
- **Where:** Hawken 50-c404 (mostly)
- **Who:** Cast of thousands
- **How:** Lots of work
- **Why:** Get experience developing complex mechatronic and robotic systems... and

because it's awesome

PART 1

The Project

Specific class objectives

- Explore the trade-offs involved in complex mechatronic/robotic systems
- Gain experience in multi-variable analytical design synthesis
- Exercise practical cyber-electromechanical integration and trouble-shooting techniques
- Build interpersonal skills working in teams

The Goal

Build an autonomous vessel to navigate from one side of a shallow water tank to the other, avoid obstacles and make landfall on a coastline, propelled only by the wind.

Key points

- Three ‘ships’ and five ‘months at sea’
 - That is, three attempts up to five minutes each
- Points are scored based on landfall location:
 - Forests and river delta (high points)
 - Deserts and islands (low points)
 - Additional points for certain ‘achievements’

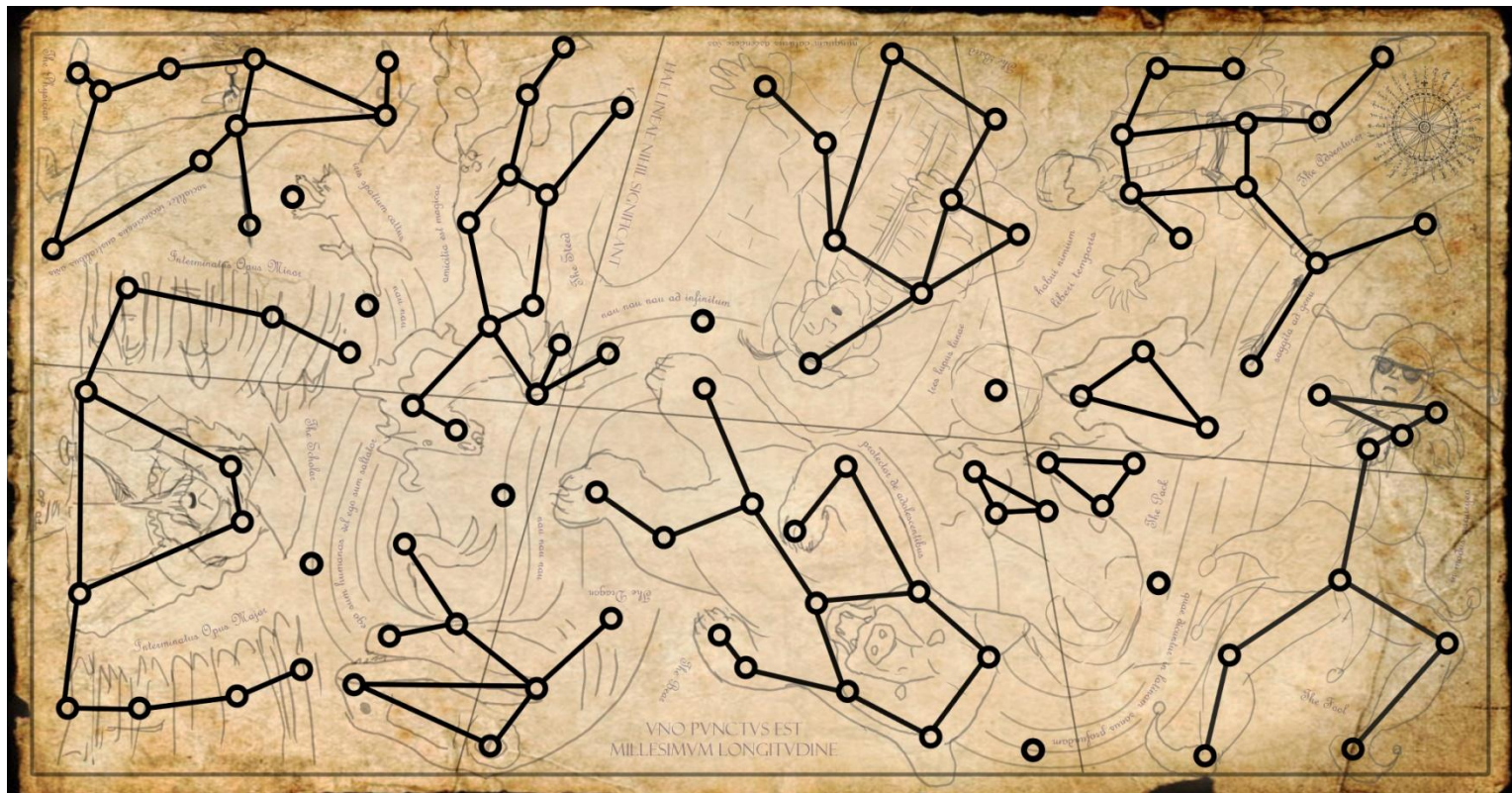
Nautical chart

- Scale map of the miniature 3D coastline in a water-filled tank

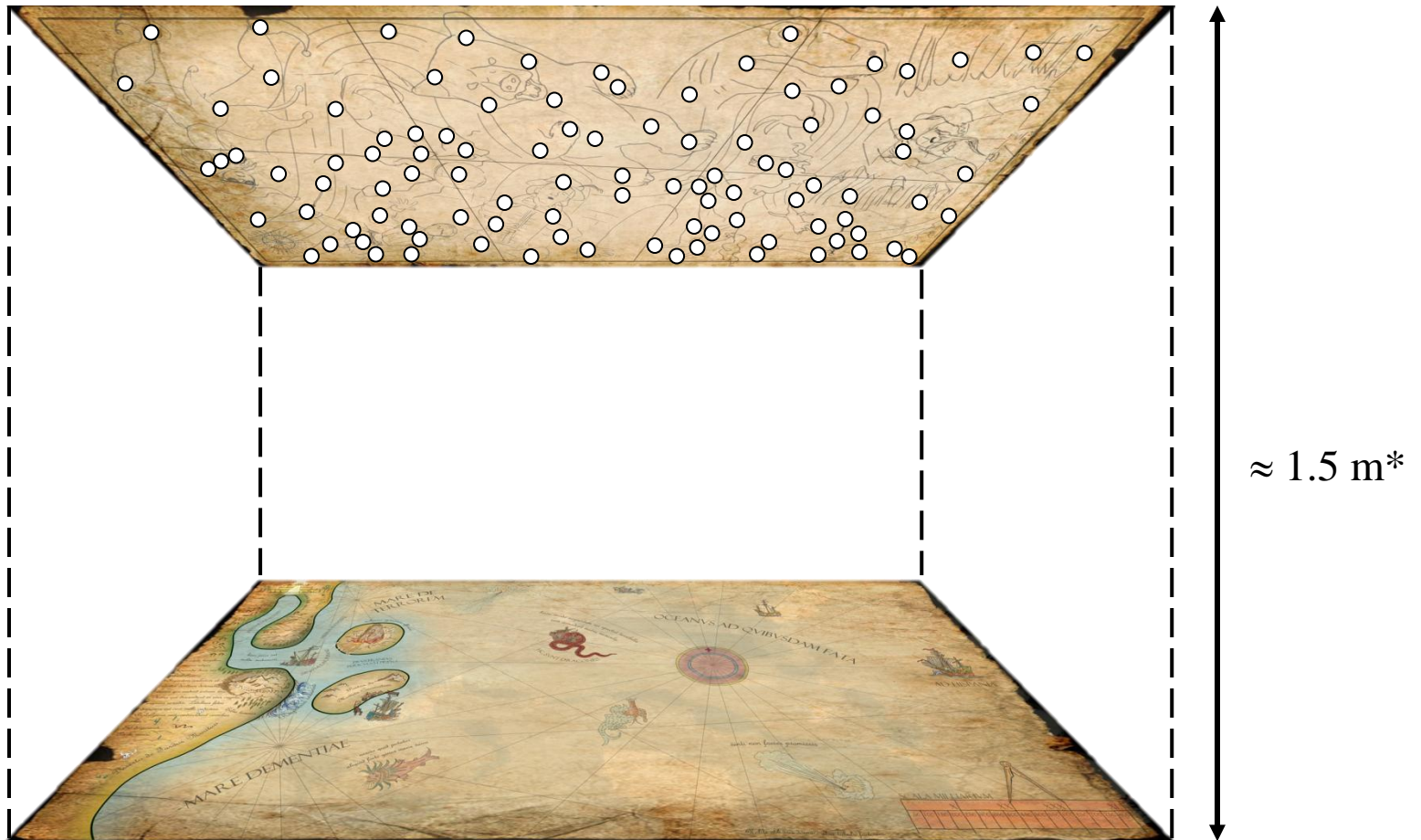


Star chart

- Map of LED lights embedded in the ceiling
 - Conveniently arranged into constellations



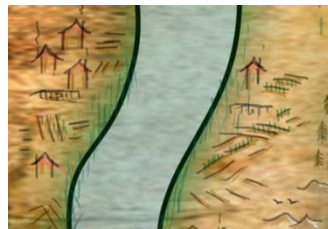
Map alignment



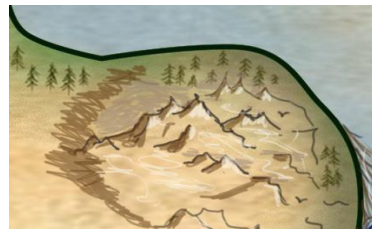
*Approximate estimate; actual distance may vary, and specification is subject to change without notice

Scoring regions

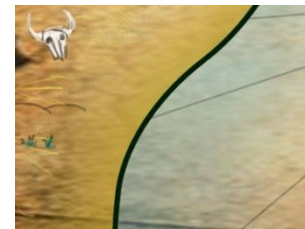
- Coastline



River delta



Forest



Desert

- Islands



Port

Hazards

- And some extra challenges just ‘cus...

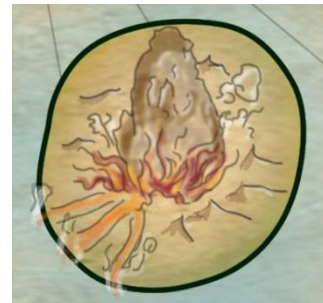
- Shallows

Shallower



Deeper

- Volcano



- The Dragon



Treasure of Axolotlzuma

- At the end of the shallow river lies the hidden temple of Axolotlzuma
 - Requires a great feat of accurate navigation and precision motion control



Reaching the temple gives you a score bonus...
and the famed treasure of Axolotlzuma!

The Rules*

- Construct one vessel (three attempts)
- Must be supported by water buoyancy
- All propulsive energy must come from wind
- Off-board computation is permitted.
- Limited to \$150 in parts/materials
- **ALL** purchases through ETSG – reimbursements will **NOT** be made

*Brief synopsis only – see Description, Rules and Regulations document for complete official rules

Scoring and achievements

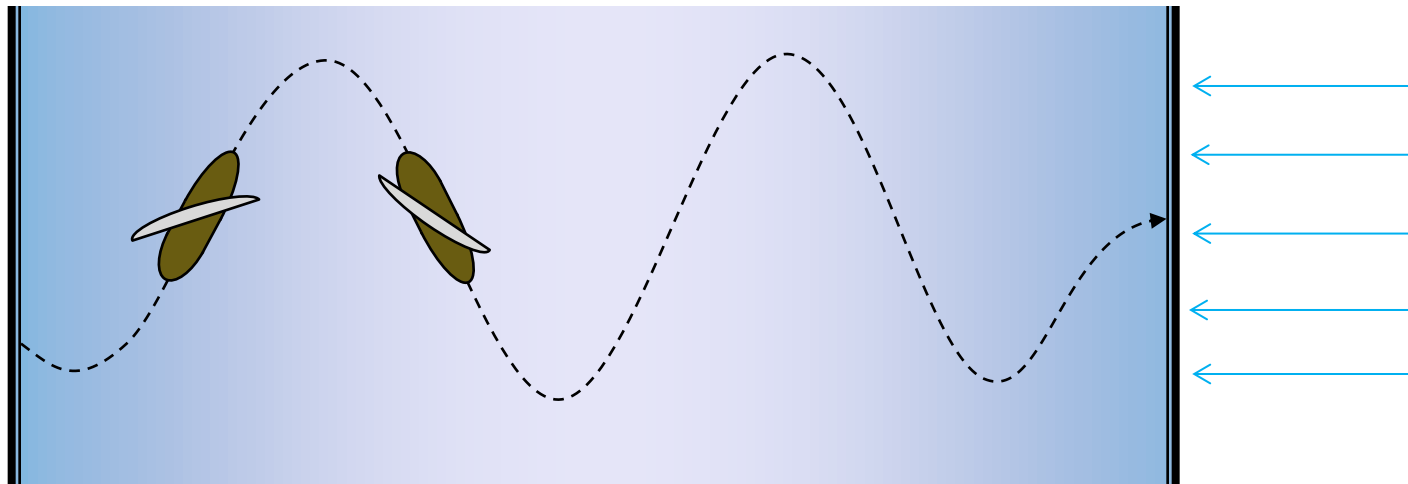
Landfall location	Points
Lost at sea	NA
Island	2
Desert	3
Forests	4
Farmland/river	5

Achievement	Points
Winter attempt*	+1
Reached the Temple of Axolotlzuma	+2
All ships reach river delta or farmland	+1
No off-board computation	+1
\$20 under budget	+1
Snagged ship freed by judge	-1

*Variable wind direction and power

Seaworthiness certificate

- To be eligible to score achievement points, your vessel must satisfy basic functionality:
Autonomously cross two meters of open water *up-wind*, powered by the wind.



PART 2

Assessment

My philosophy

- Engineering is the highest, purest and most noble pursuit of the human experience
- You are training to be engineers, and this is a chance to actually practice engineering
- You are not your grade*
- There will be second chances

* They make me assign you a grade

Deliverables

- Design Brief – 10%
- Progress Review 1 – pass/fail[†]
- Progress Seminar* – 10%
- Progress Review 2 – pass/fail[†]
- Preliminary Report – pass/fail[†]
- Final Product Demo* – 60%
- Final Project Report – 20%

* Team assessment with peer and tutor weightings

[†] More on this later

Design Brief

Due March 15th – 10%

- Show you have understood the problem, its scope, and its requirements and developed insights into how the problem may be addressed.
- Detail your part of the project, the key challenges you will face and how it fits into the overall solution.

Progress Reviews 1 and 2

Due 18 – 22 March and 29 April – 3 May

- Tutor-mediated meetings
- Demonstrate your progress in the preceding period with tangible **evidence** of your contribution to the team
- Pass/fail mark based on quality of work and relative progress towards the goal

Progress Seminar

Due 8 – 12 April (team assessment) – 10%

- Provide a 10 minute seminar outlining your approach and progress towards developing a solution to the problem.
- Each student should present for roughly equal time.

Preliminary Report

Due 17 May

- Describes the approach to solving the subtask, how it relates to the other subsystems within the project and the analytical process that was used in developing the solution.
- Show the formal, disciplined, quantitative engineering process followed demonstrating the feasibility of the approach taken.

Final Product Demo

Due 27 – 31 May (team assessment) – 60%

- Show your system works!
- Marks awarded for functionality, achievements and build quality.
- Hand in everything needed to make your system work, including documentation and printouts of design schematics.

Above all: Convince me you can *engineer*.

Final Report

Due 31 May

- Identical to the preliminary report, but with an added addendum incorporating anything that changed in the last two weeks.
- Prelim. report will be returned with comments so that you have an opportunity to revise your work and improve upon it,

Just like in real life!

Incremental demos

- Spontaneous night-before failure of hardware systems is **brutal** and **unfair***.

Just like real life!

- If your system is sort-of working early, you can have it tested in an incremental demo.
 - If the final demo mark is less than what was scored in an incremental demo, you will be awarded the incremental demo mark.

Incremental demos

- Scored just like final demo, but final mark is capped according to time left in semester
 - Week 7: 25%
 - Week 9: 50%
 - Week 11: 75%
 - Incremental demos are by appointment only*
- * Do not attempt a demo with an obviously non-functional system or you may forfeit future incremental demo attempts

Pass/fail caps

- Subpar (or missing) pass/fail submissions incur a cap on your final grade
 - Project reviews: 10% each
 - Preliminary report: 20%
- These mark caps are *cumulative*
 - If you were to fail all of them, your maximum achievable grade for the course would be 60%

Calendar at a glance

Week	Dates	Lecture	Reviews	Demos	Assessment submissions
1	25/2 – 1/3	Introduction			
2	4/3 – 8/3	Principles of Mechatronic Systems design			
3	11/3 – 15/3	By request			Design brief
4	18/3 – 22/3	By request	Progress review 1		
5	25/3 -29/3	By request			
Break	1/4 – 5/4				
6	8/4 – 12/4	By request	Progress seminar		
7	15/4 – 19/4	By request		25% demo	
8	22/4 – 26/4	By request			
9	29/4 – 3/5	By request	Progress review	50% demo	
10	6/5 – 10/5				
11	13/5 – 17/5			75% demo	Preliminary report
12	20/5 – 24/5				
13	27/5 – 31/5	Closing lecture		Final testing	Final report and addendum

You are here ↗

Try to work ↗

Paul at junket

} ↗

Madness week ↗

PART 3

Class Organisation

Blackboard and website

- This class has both a Blackboard page and outwards-facing (read: “splashy”) website
 - If the content of the two were to ever differ, the Blackboard page is authoritative (but they won’t)
- Blackboard page:
<https://learn.uq.edu.au/>
- Class page:
<http://robotics.itee.uq.edu.au/~metr3800/>

Weekly schedule

- Lectures – 2 hours once per week
 - Technical topics driven by student requests
- Practicals – 2 hours twice per week
 - Tutors available in lab (but 24/7 access)
- “Contact” – 2 hours twice per week
 - Time set aside for meetings, demos, etc.

Altium notes and soldering tutes will be made available (details TBA)

Lectures

- Boring, useless lectures help nobody
- I will endeavour to provide lectures that are educational, useful and (sort of) entertaining
- Lectures will be student-driven: you tell me what you want to learn about and I'll teach it

Lectures

- Lecture 1: Introduction to the project
- Lecture 2: Principles of mechatronics system design
- Lecture 3: ??
- Lecture 4: ??
- ...

Topics may be nominated by emailing me,
and then voted for on a doodle poll

Some suggested topics

- Energy transfer
- Fluid mechanics
- Projective geometry
- Computer vision
- Navigation and path-planning
- Sensor-fusion and filtering
- Localisation
- Schopenhauer and philosophical pessimism

Teams

- Teams will each consist of four people
 - Except for when they don't
- Teams will each be assigned a tool kit
 - Complete kit must be returned *or else*
- Work together! Contact sessions are set aside for team meetings and collaboration

Teams

- You will have to work with people you hate*
Just like in real life!
- You may email me and request one person with whom you do not want to work
- Otherwise, teams will be allocated by magic

*If you don't hate them now, you will by the time you're done

Laboratory space

- Expected: Hawken c404 + c403
- Given: Hawken c404
- Consequence: Be neighbourly
 - Lockers for project work under desks
 - Share space and resources
 - Get started early; consider how you can work most effectively in the final two crunch weeks

Laboratory space

- Keep the lab clean and orderly
- Cleanliness “warning light” system in effect
 - Status noted on Blackboard/class website

Green: Full speed ahead

Yellow: Clean up needed

Red: *Uh oh.**

*Lab will be locked until next prac, wherein the lab *will* be cleaned (or else remain locked)

Laboratory space

- The laboratories are governed by the UQ risk management policy
- To work in the lab:
 - You MUST have completed the induction
 - You MUST have read the lab risk assessment
 - You MUST wear appropriate footwear
- You will be barred from the lab if you do not follow the guidelines

The testing tank

- The vessels will be tested in an actual water tank with actual water
 - Still under construction – hopefully ready by mid-late March
- P&F have decreed that the tank (or any volume of water) cannot be in c404
 - Instead, it will be stored outside the ELCX or under Frank White

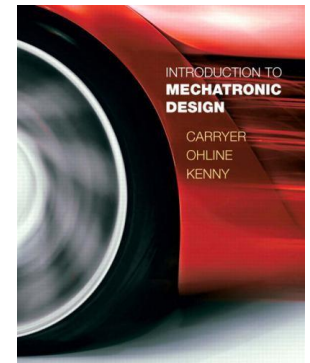
Working with the tank

- The tank will be unlocked during scheduled practical sessions
 - Available other times by request
- Some simple rules:
 - You must wear rubber-soled, closed footwear
 - Do not walk on/in the tank
 - Do not lean against the tank
 - Do not eat the tiny trees

Resources

- Website
 - Everything will be posted on the Blackboard class website: (learn.uq.edu.au)
 - Better-looking class website will mirror course materials: (robotics.itee.uq.edu.au/metr3800)
 - FAQ document will be updated periodically
- Textbook
 - “Introduction to Mechatronic Design”
by Carryer, Ohline and Kenny

(recommended but not required)



What happens next?

- You will be assigned groups
 - Groups posted on class site by next Monday
 - If you have exclusion requests, email me ASAP!
- Attend the afternoon practical session in Hawken c404 Wednesday next week
 - Toolbox handouts
 - Room inductions
- Start thinking about solutions!

Knowledgeable people

- Course Coordinator and Chief Conspirator:
 - Paul Pounds
- Technical Staff
 - Peter Bleakley
 - Ray White
 - Dejan Subaric
 - Keith Lane
 - Doug Malcolm
 - Keith Bell
- Tutors:
 - Chris Ham (aka ‘Kit’)
 - Adam Keyes
 - Jared Page
- Emergency Auxiliary Temporary Back-Up Replacement Stand-in Teaching Faculty
 - Prof. Steve Wilson
 - Dr. Michael Kearny

Contact info

If anything is bothering you, bring it up *early*

- Rules questions
- Technical issues
- Ordering
- Disenfranchisement with the sociopolitical gestalt
- Assessments
- Group problems
- Enrolment

➤ Serious? Email first to arrange a meeting

➤ No? Just stop on by! (but email is good too)

Contact info

Who: Me!

Why: Questions, issues, concerns, ennui!

Where: GPS 78-348 or Wordsmiths

When: 10 to 4 – by appointment (or drop in)

What: Coffee or coke

How: paul.pounds@uq.edu.au

Questions?



Tune-in next time for...

Principles of Mechatronic Systems Design

or

“Striking a Balance is Making Everybody Equally Unhappy”

Fun fact: A distressing number of utterly useless details in this project are unnecessarily authentic and well-researched