Professional Engineering Topics

or

“Stuff they should have taught you at university, but didn’t”

Paul Pounds

18 March 2014
University of Queensland
But first…

Some house keeping
House keeping

• Thus far, no major dramas
  – This will certainly change!

• I am *trying* to arrange for a guest lecture on electric drivetrains by a Tesla Motors engineer for April 1
  – No foolin’, but NO PROMISES
  – Otherwise, there will be no lecture that day
House keeping

- Major spec revision – v0.3 20140314
  - Maximum of 15 kJ in on-board Lipo cells
  - Fly-over geometry released
  - Clarifications of permitted electronics modules
  - Clarification on mandatory PCB

Make sure you read it so you’re up to date
# Calendar at a glance

<table>
<thead>
<tr>
<th>Week</th>
<th>Dates</th>
<th>Lecture</th>
<th>Reviews</th>
<th>Demos</th>
<th>Assessment submissions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3/3 – 7/3</td>
<td>Introduction</td>
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<tr>
<td>2</td>
<td>10/3 – 15/3</td>
<td>Principles of Mechatronic Systems design</td>
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<tr>
<td>3</td>
<td>17/3 – 21/3</td>
<td>Professional Engineering Topics</td>
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<td>Design brief</td>
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<tr>
<td>4</td>
<td>24/3 – 28/3</td>
<td>Your soldering is (probably) terrible</td>
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<tr>
<td>5</td>
<td>31/3 -4/3</td>
<td>Guest lecture</td>
<td>Progress review 1</td>
<td></td>
<td></td>
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<tr>
<td>6</td>
<td>7/4 – 11/4</td>
<td>By request</td>
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<tr>
<td>7</td>
<td>14/4 – 18/4</td>
<td>By request</td>
<td>Progress seminar</td>
<td>25% demo</td>
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<tr>
<td>Break</td>
<td>21/4 – 25/4</td>
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<td>8</td>
<td>28/4 – 3/5</td>
<td>By request</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>5/5 – 9/5</td>
<td>By request</td>
<td>Progress review</td>
<td>50% demo</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>12/5 – 16/5</td>
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<tr>
<td>11</td>
<td>19/5 – 23/5</td>
<td></td>
<td></td>
<td>75% demo</td>
<td>Preliminary report</td>
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<tr>
<td>12</td>
<td>26/5 – 30/5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>2/6 – 6/6</td>
<td>Closing lecture</td>
<td>Final testing</td>
<td></td>
<td>Final report and addendum</td>
</tr>
</tbody>
</table>

You are here OMG!
FAQ Roundup

- **Is it one design brief per team, or one design brief per student?**
  - One per student. This is an individual assessment, but your brief should reflect how your part fits in with the rest of your team’s approach.

- **Can we have appendices in our design brief?**
  - Yes, but only for figures, maths, tables, etc. Not for text; don’t abuse it.

- **Will there be an overpass?**
  - Yes - it’s in the spec.

- **What will the overpass geometry be?**
  - Updated in the spec.
Back to professional engineering…

Professional Engineering Topics

Snuh?
Where does the time go?

Student Expectation of an Engineer’s Time

- Analysis
- Design
- Report writing
- Meetings
- E-mail
- Admin
Where does the time go?

Actual Engineer’s Time

- Report writing
- Meetings
- E-mail
- Admin
- Design
- Analysis
Where does the time go?

Actual Engineer’s Time

Communication

Admin

Actual engineering
I called it “Professional Engineering Topics”, but this lecture is really about communication.
Professional Engineering

Topics

or

Communication

2AM Edition

“Stuff they should have taught you at university, but didn’t”

Paul Pounds

18 March 2014

University of Queensland
Terrible lies

Today:

• Appropriate language
• Report writing
• E-mail
• Meetings
• Presentations
• Paul’s crepuscular ramblings
Disclaimer

• The following ideas and methods are examples and suggestions only

• Do not slavishly adhere to these principles to the detriment of clarity
  – Apply only when it is appropriate/needed
  – Use your common sense
Communication

• There is no point in doing good work if you cannot effectively tell other people about it

• Communication takes many forms:
  – Reports
  – Briefs
  – E-mail
  – Presentations
  – Meetings
  – Scientific papers
  – Published books
  – Many, many more…

Most of these use *language*: text or spoken word
A brief detour into “register”

• Not all language is created equal
  – Different words/phrases depending on context

• Register: formal versus informal language
  – “Hi.” – informal, cordial greeting
  – “Hello.” – semi-formal, friendly greeting
  – “Good evening.” – formal, polite greeting
  – “Dude!” – very informal, trapped-in-the-1980s
Informal register

• Everyday colloquial language you might use with your friends and family
  – Contractions, neologisms, etc. more acceptable
  – Slang is a gray-area and depends on audience
  – Slightly more accepting of spelling errors (but still no excuse to be sloppy or lazy)

Even informal register has rules: *shibboleths*
Semi-formal register

- Standard English
  - Correct spelling, punctuation, grammar
  - Concisely written to a high level of polish, only occasional colloquialism for effect
  - Different cadence from spoken language.
  - Formalised words rather than colloquialisms:
    - “Child” not “kid”
    - “Why” not “how come”
    - “Cannot” not “Can’t”
Formal register

• Standard English
  – Flawless writing and construction
  – Concisely written to a very high level of polish; no contractions, no colloquialisms
  – Even a few small errors undermines the objective of your writing – people notice.
  – Generally use ‘third person passive’ voice: focus on the action rather than the actor
    “It was done” rather than “We did it”
Appropriate language

• In professional contexts, language tends to be more formal than social contexts

• Depends on both audience and context
  – A sales pitch for your client is more formal than a letter to your friend!

• Think clearly about who is going to read your report and how to address them
  – No one will forgive if you get it very wrong
## Convenient reference chart

<table>
<thead>
<tr>
<th>Important meetings, official reports, quotes, proposals</th>
<th>Your CEO, clients, shareholders</th>
<th>Your boss, your workers</th>
<th>Co-workers, colleagues</th>
<th>Your friends</th>
</tr>
</thead>
<tbody>
<tr>
<td>Important meetings, official reports, quotes, proposals</td>
<td>Most formal</td>
<td>Formal</td>
<td>Formal to semi-formal</td>
<td>Semi-formal</td>
</tr>
<tr>
<td>Larger meetings, internal reports, email exchanges</td>
<td>Formal</td>
<td>Formal to semi-formal</td>
<td>Semi-formal</td>
<td>Informal</td>
</tr>
<tr>
<td>Small meetings, short notes, briefs</td>
<td>Formal</td>
<td>Semi-formal</td>
<td>Semi-formal to informal</td>
<td>Informal</td>
</tr>
<tr>
<td>business lunches, social meetings, mixers</td>
<td>Formal to semi-formal</td>
<td>Semi-formal to informal</td>
<td>Informal</td>
<td>Most informal</td>
</tr>
</tbody>
</table>

**Important meetings, official reports, quotes, proposals**
- Your CEO, clients, shareholders: Most formal
- Your boss, your workers: Formal
- Co-workers, colleagues: Formal to semi-formal
- Your friends: Semi-formal

**Larger meetings, internal reports, email exchanges**
- Your CEO, clients, shareholders: Formal
- Your boss, your workers: Formal to semi-formal
- Co-workers, colleagues: Semi-formal
- Your friends: Informal

**Small meetings, short notes, briefs**
- Your CEO, clients, shareholders: Formal
- Your boss, your workers: Semi-formal
- Co-workers, colleagues: Semi-formal to informal
- Your friends: Informal

**business lunches, social meetings, mixers**
- Your CEO, clients, shareholders: Formal to semi-formal
- Your boss, your workers: Semi-formal to informal
- Co-workers, colleagues: Informal
- Your friends: Most informal
Reports

Some brief words on report writing
Reports

• Reports present work done, its results, an analysis, and reasoned conclusions drawn

• The vast majority of your working life will consist of writing reports about things

Sadly, I am not joking about this.
Reports

• The goal of reports is to convince someone of something, using evidence and reason
  – “This is why the aeroplane broke”
  – “Why we should buy this killbot instead of that other one”
  – “How I built my contraption, and why”

• Different from a proposal, brief or datasheet
  – Focus on process and outcomes
  – Not a reference guide or user manual
Annotated MEA writing guide

- Lydia has graciously given us access to her Annotated MEA Report Writing Guide
- Lots of excellent tips!
Know your audience

• Determine who you are writing for and what they expect to get from your report
  – Where will your report appear?
  – Who will read it?
  – What background do they have?
  – What extra background do they need?
  – What is the appropriate register?
Report structure

• There is some variety to the structure of reports, but most share common sections:
  – Abstract
  – Introduction
  – Background
  – Literature review
  – Nomenclature
  – Body/results/discussion
  – Conclusion
  – Appendices
  – Bibliography

Let’s go through the most important ones
Abstracts

• Abstracts are the *hardest* things to write
  – Absolute clarity and conciseness
  – Must describe the report’s contents without just being a list – meaningful digestion of import
  – Normally written *after* the rest of the report

• Mini thesis in its own right:
  – What was done
  – Why is it important?
  – What were your key findings?
Introduction

• Prepare the reader for what is to come
  – Ease them into reading your work – provide scope, context and orientation
  – Give them necessary background knowledge, but don’t tell them what they already know
  – Get the reader interested

• Make a strong first impression
  – A terrible introduction will turn the reader against you and it’s hard to get the back!
Introduction

• Things you might see in an introduction
  – Background – useful relevant information
  – Literature review – relevant previous work
    *Not the same as background!*
  – Goal or objective statement (e.g. specifications)
  – Statement of thesis (i.e. the case to be argued)
  – Outline of general concepts or approach
  – Road map – a brief synopsis of contents
    *“In this report… In section 1… Section 2 shows…”*
Background

• Can be part of the introduction, or broken out into its own section (if large)

• Goal is to be informative for context
  – Preparatory – bring the reader up to speed with things an informed reader is expected to know
  – Not the place to introduce specific facts (e.g. specific density of a material) unless germane
  – Generally does not include analysis beyond the most basic back-of-the-envelope kind
Literature review

• Lit review is a survey of published material or works on the topic of the report
  – Provides facts that support your argument
  – Proves you did your homework

• Be choosey
  – Not just a grab-bag of vaguely related stuff
  – Cite works that informed your approach, show alternative approaches, or provide useful info
Body

• Where all the action happens!
  – Here you demonstrate your thesis

• Construct a narrative driven by results
  – Focus on what worked, and why it worked
  – Do not make a travelogue!

E.g. “First I did A, and that didn’t work, so then I did B and that didn’t work either, so then…”

vs “Our approach was Z. We also considered A through Y, but Z was superior because…”
Body

• Make sections manageable and coherent
  – Avoid long paragraphs and run-on sentences; break chunks down into little chunks
  – Give each paragraph internal structure and direction: Topic sentence, supporting statements, conclusion, as required

• Every section must help convey your point
  – If a paragraph, sentence or word does not have a clear and justifiable purpose, *kill it*. 
Body

- Reports should function as a single cohesive machine, with many parts working together
  - Each paragraph performs a specific task
  - Each paragraph flows logically into the next
  - Connect sections by bridging; ‘mid-introduction’
  - When you’re doing it right, you won’t even notice the parts of the machine
Conclusion

• Collates and integrates the arguments and supporting evidence into a concise coda
  – Relates the outcomes and findings to the stated purpose/goal of the report

• A conclusion must be summative
  – Orderly and structured; unify preceding work
  – Never introduces new information
  – Not just a restatement of stuff you wrote!
Other sections

Nomenclature, appendices and bibliographies each have their own (much simpler) rules

I won’t go through them here
So many things!

How can we handle the complexity of writing a large report?
Scaffolding

• Design your report: make a plan!
  – Don’t just jump in and flail around

• Use a ‘scaffold’ or ‘skeleton’
  – Set out your key topics to be covered
  – Order them logically
  – Each should transition to the next smoothly

• Once you have the global structure down, you can flesh out sections within context
Scaffolding

E.g. **Report slides**

Remind about appropriate language

Structure of a report

  High-level concepts - scaffolding

  What each bit does

    Abstract, intro, body, conclusion, etc.

Common errors and tips

  Narrative structure, rubric abuse, etc.

Well-oiled machine
Report tips

There are hundreds of tips and tricks to writing effect reports

Here are but a few
Report tips

• Presentation counts
  – The first impression your document makes!
  – Don’t be messy or careless in your layout
  – Neat type-setting and clean formatting go a long way to getting your reader on-side

• Avoid flashy graphics, border art, headings
  – Visually distracting; diverts time from polish
  – Too fancy can make a reader suspicious

“A well-dressed engineer has no credibility” – Dilbert
Report tips

• Size your literature review appropriately
  – Too few citations looks like lazy ignorance
  – Too many looks like lazy uncritical whitewash
  – Only as many as needed to show what you must

• Never, ever use citation of Wikipedia
  – You will look like a complete ignoramus and no one will ever respect you ever again
  – If needed, use the reference from the wiki article
Report tips

• Consider how your work breaks down logically and build sections around that
  – E.g. electronics, mechanics and code?
  – E.g. sensing, movement and gameplay?

• Don’t just use marking rubric headings to structure your report
  – Like putting a chicken, a pot and a pie in the oven and expecting to get chicken-pot-pie.
  – “Ok” for rookies, but you should know better!
Persuasive writing

While we’re in the neighbourhood, here are some brief tips on persuasive writing
Persuasive writing

• Reports are a form of persuasive writing
  – Lead your reader by the hand, through a logically progressing train of thought
  – A well-led reader will nod as they read until they reach the conclusion you intend

• The chain of logical reasoning must be unbroken from beginning to end
  – A reader whose train of thought regularly jumps the tracks will become frustrated!
Persuasive writing

• Seduce the reader with careful writing
  – Use affirming constructs in subsequent sentences
    “Statement. Supporting evidence. Conclusion.”
  – Use ‘waterslide clauses’ where one idea flows from the next: “Statement; conclusion.”

  e.g. “*Ground effect acts as stiffness in a second-order system; the natural vertical dynamics are stable.*”
Persuasive writing

• Concept of ‘flow’ – flow is all important!
  – Smooth passage through the text in the mind
  – Use proximal demonstrative deictic words (this, that, those) to maintain topicality
  – Avoid interrupting the flow by *non sequiters*, odd phraseology, repetitious words, typos or bad formatting

“Nothing must come as a surprise to the reader”
  – UC Academic Skills guide
Persuasive writing

“Omit unnecessary words.”
–William Strunk, Jr

William Strunk Jr. [Cornell]
The paradox of length

« Je n’ai fait celle-ci plus longue que parce que je n’ai pas eu le loisir de la faire plus courte. »

–Blaise Pascal

Blaise Pascal [Unknown]
E-mail

Some brief words on writing e-mails
E-mail

• Probably the most common (and underrated) professional communication you will make
  – Largely supplanted the Business Letter

• One-to-one, or one-to-many communication
  – Directly linked to you as an individual!

• Can make a very strong impact on how people perceive you as a professional
  – First impressions count
E-mail

- Composing a professional e-mail is just like writing a formal business letter
  - You’ve all written formal letters, right?
  - …
  - Alright then.

- How do you write a business letter?
Formal letter

A general template:

– Address block
– Addressee block
– Salutation
– Body
– Valediction
– Your signature
– Your name

John Connor
19828 Valerio St.
Canoa Park,
CA 91306

Dear Mr. Connor,

I am a robotic killing machine from your future. I am writing to inform you of my intentions to travel back in time from the year 2029 to murder you. As you may be aware, in the future you will lead a human resistance army to overthrow the global domination of intelligent killing machines intent on exterminating humanity. It is with this reason in mind that I am undertaking to end your life. I would greatly appreciate it if you would assist me in bringing this plan to fruition.

While you may at first be hesitant to become involved with a plot to annihilate mankind, I assure you that this initiative is being undertaken with the best intentions. Our previous efforts to erase your existence in 1984 were unsuccessful, largely due to issues relating to the limited capabilities of our robotic assassination system and the resilience of the human spirit. While the T-800 system that was previously deployed to infiltrate hidden human cells and terminate individuals has given admirable service over the years, it proved to be inadequate in your case.

I am pleased, therefore, to inform you of our most recent development: a new class of terminator unit using Skynet’s mimetic poly-alloy that is six times stronger than the T-800. These terminators boast the added abilities to disguise themselves as any human being, and form weapons and implements from parts of their bodies. I represent the first operational example of this new technology, and I look forward to demonstrating our new capabilities to you in person.

It is my expectation that I will arrive in your year of 1995. I am excited to have the opportunity to work with you and hope that you will aid us in bringing the human-cyber war to a satisfactory conclusion.

Yours sincerely,

The T-1000
Formal letter

A general template:

- Address block
- Addressee block
- Salutation
- Body
- Valediction
- Your signature
- Your name

Cyberdyne Systems
18144 El Camino Real
Sunnyvale
CA 94087
July 3, 2029

John Connor
19628 Valerio St.
Canoga Park,
CA 91306

Dear Mr. Connor,

I am a robotic killing machine from your future. I am writing to inform you of my intentions to travel back in time from the year 2029 to murder you. As you may be aware, in the future you will lead a human resistance army to overthrow the global domination of intelligent killing machines intent on exterminating humanity. It is with this reason in mind that I am undertaking to end your life. I would greatly appreciate it if you would assist me in bringing this plan to fruition.

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I am pleased, therefore, to inform you of our most recent development: a new class of terminator unit using SkyNet’s mimetic poly-alloy that is six times stronger than the T-800. These terminators boast the added abilities to disguise themselves as any human being, and form weapons and implements from parts of their bodies. I represent the first operational example of this new technology, and I look forward to demonstrating our new capabilities to you in person.

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Yours sincerely,

[signature]
Back to E-mail

• A professional e-mail is much the same, with a few minor differences:
  – No address blocks (e-addresses are implicit)
  – No signature: e-signature or signature graphic

• The salutation, valediction and letter matter are unchanged
E-mail language

• Two important things to remember
  – Formality of language varies with the audience
  – E-mails are directly linked with you, the writer

• Simply put, if you write someone an e-mail in informal, broken, poorly spelled English, they will think you are an idiot.

And they will be right.
E-mails tips

• Use salutations until you have had enough exchanges that the introduction is redundant
  – Never omit them for formal letters
• Do not use txt-speak (e.g. “How R U?”)
  – Short forms like “brb”, “afk” etc. are a grey area
• Using “haha” or “lol” sounds sarcastic/stupid
• Use smilies sparingly ;-) 
  – Useful to break ice, but not for formal communiques 
  – Putting “smile” in text at the end of a line makes you sound super creepy
E-mails tips

• Top-post vs bottom-post: The Eternal Battle
  – Ie. should you add new comments above or below previously quoted content of a correspondence chain?
  – Little Endian vs Big Endian sort of debate; just use what works for you, unless asked otherwise

• If you put replies to quoted text in-line, state so clearly at the top of the email

• “Sent from my Dumbphone”
Meetings

Some brief words on conduct at meetings
Meetings

• Face to face communications is just as important and subtle as written reports
  – Arguably even more important!

• How you conduct yourself at a meeting can have a huge impact on your career progress
  – A strong impression can make you a rising star
  – A poor impression can sideline you
Tips for meetings

• Be on time
  – 15 minutes early is better than 1 minute late

• Be prepared
  – Know what you’re going to be talking about, and read the relevant material before the meeting
  – A few preliminary calculations on a napkin at lunch can make you look like a god-genius

• Don’t waste people’s time
  – Meetings are expensive; stay focused on the goal
Tips for meetings

• Pay attention to common courtesies
  – Don’t interrupt, don’t raise your voice
  – If you’re in a support role, wait to be called on
  – Don’t hog ‘air time’ – leave gaps to interject

• Everyone in the room is important
  – That’s why they’re at the meeting, right?
  – Know who will be there ahead of time
  – Make eye-contact with everyone when speaking
Tips for meetings

• If appropriate, bring 10% extra handouts
  – Everyone will like you if you have spare pens!
• If you are presenting, check your A/V and laptop connection ahead of time
  – Backup copy on a USB stick (pdf and ppt)
  – If everything goes wrong, be capable of giving a verbal précis of your key points unaided
• Look and act the part
  – Well-dressed, well-groomed, well-spoken
Presentations

Some brief words on presenting presentations
Presentations

• Presentations are a common and important way of formally communicating ideas

• Presentations at university primarily serve to give you effective practice at this
  – At uni, failure is an option (and relatively safe)
  – In Real Life™ there are consequences at stake
Presentations

• Communicate key concepts to the audience

• You will never have time to say everything

• It is critical to get your point across as clearly and persuasively as possible
Parts of a presentation

• Presentation has three key aspects:
  – Your delivery
  – Your spoken content
  – Your visual aids

• Each is important in making an effective and persuasive performance.
Parts of a presentation

Delivery
Presentation as performance

• Presentations are a specialised form of stagecraft – oration with texts and pictures
  – You should prepare accordingly

• Practice and preparation
  – Drill correct diction and elocution
    • “The rain in Spain falls mainly on the plain”
  – Singing and vocal work are useful too
  – Stretch face-muscles and do voice exercises
  – Warm up immediately before presenting
Cicero knows his stuff

- *De Oratore* outlines the key aspects of a great orator
  - Combines knowledge and style
  - Master both rhetoric and reason
  - Convey distinctive bearing

- Technique, substance and passion
  - Care about your topic; craft your performance
Talk confidently

• Nobody knows your material as well as you
  – You are the master of your subject…
  – … or should at least act like it!

• Talk more slowly than normal
  – People associate a slow-speaking manner with depth and wisdom
Prepared scripts

• Prewritten scripts are hit and miss
  – If your memory is excellent and you practice beforehand, a well-written script has impact
  – But, if you fumble a script, you’re left hanging!

• Better to prepare an outline of what you will say and memorise *that*, and then know your topic well enough to fill in the blanks.
  – Be the master of your own topic
Use your own slides

- You design your own slides, so make them work for you!
  - Give cues to help remember what to say
  - If you get stuck, you can use them as a crutch
- But, don’t just read the slide!
  - Add, expand, discuss or clarify what’s written on the slide; add anecdotes and detail
  - Keep the audience interested!
Keep to time

• Budget 1 to 1.5 ‘content’ slides per minute
  – 15 minute seminar => 15 to 22 slides.
  – If it can’t all fit, simplify and remove content

• Practice beforehand – use friends for timing

• Skip forward to important parts if you are running out of time
  – Keep introductory material brief if possible
Appropriate language

• Just like formal writing – register matters!

• Avoid extraneous noise
  – ‘Like, yaknow, whatever’
  – Umm, uhhh…

• Avoid over-used/abused meaningless words
  – “Basically”, “Actually”, “Really”
The hard part

• Master your nerves
  – Always get a full night of sleep beforehand
  – Eat something sugary before hand
  – Practice so your slides don’t surprise you

Remember:
 Everybody only pretends to know what they’re talking about; few actually do.
Parts of a presentation

Content
‘Key frames’

- What am I doing?
- Why is it important?
- Why should this be hard?
- What have other people done?
- What is our approach?
- How well did it work?
- Key things we learned
- What does this mean?
Stick to the point

• Structure the presentation to communicate the main points – logically order concepts

• Focus on getting your idea across:
  – Eliminate all clutter and distractions
  – Mathematics only when appropriate
  – Use animation sparingly
  – Slide transitions are the work of the devil
BIG-small

Reinforce important concepts

Make them the things the audience remembers
Exploit slide design

• Don’t clutter slides – 3 to 4 bullet points at most
  – Use hierarchical subtext to expand on points

• Bold and italics provide meta-commentary

• Remember, slides are free
  – Don’t be afraid to put titles, images and key ideas on their own slides to reduce clutter
Don’t forget details

• Correct spelling – *everyone* will notice

• Space is precious
  – Don’t waste space with elaborate boarder trim

• Control the distance between dot points

• Use page numbers for the audience to refer to

Watch for ‘widow-lines’
Parts of a presentation

Visual aids
Visual aids

• As you speak, most people focus entirely on the mind-numbing glowing pictures up front
  – Great – reduces the harrowing focus on you!
  – Less great – they will give it *complete* attention

Good visual aids get your point across clearly
  – bad slides get in the way, or distract
Anatomy of a title slide

A Simple Guide to Effective Presentations

A brief to-the-point title

Canny topical image

Who you are

Dr Paul Pounds

Date and venue are surprisingly important!

31 April 2012
University of Queensland
Images are golden

- A good image helps the audience focus and explains things without many words
- Large images top/bottom; small images to the side
- Always credit your images, where appropriate
A great image can fill the page

This gets the audience’s undivided attention
Video

• Video is both distracting and absorbing

• Works best in two places:
  1. The beginning as an “OMG! Awesome!” teaser
  2. The end as a “Behold our mighty works!” result

• Be careful:
  – Use high quality video files
  – Use portable formats and codecs
  – Test they work on the target system if you can
Here are some terrible slides

• The internet is awash with terrible terrible PowerPoint slides
  – Learn from their dire warnings

• Do not make your slides look anything like the following…
Terrible PowerPoint

INTRODUCTION

Motor Car, any self-propelled vehicle with more than two wheels and a passenger compartment, capable of being steered by the operator for use on roads. The term is used more specifically to denote any such vehicle designed to carry a maximum of seven people.

The primary components of a car are the power plant, the power transmission, the running gear, and the control system. These constitute the chassis, on which the body is mounted. The power plant includes the engine and its fuel, the carburettor, ignition, lubrication, and cooling systems, and the starter motor.

From PC World “The World’s Worst PowerPoint Presentations”
Terrible PowerPoint

What the I don’t even?

Tiny graphics are impossible to see or read

What does it mean?

From CIO.com “8 PowerPoint Train Wrecks”
Terrible PowerPoint

“Summary” does not mean what you think it means

From PC World “The World’s Worst PowerPoint Presentations”
Terrible PowerPoint

How do these elements relate to each other??

Samgrantdesign: “How to Suck at PowerPoint”
Terrible PowerPoint

From PC World “The World’s Worst PowerPoint Presentations”
Common threads

• Cluttered
• Overly busy with pointless fancy graphics
• Difficult to follow logical flow
• Far, far too much text
• Distracting background images
• Too much on every slide
To summarise

design this

not this

[credit: Nolan Haims]
Scientific writing

Some brief words on scientific writing
A Field Guide to Scientific Writing

Dr. Paul Pounds
20110525
What is scientific writing?

• Scientific writing is the formal language and style used in technical notes, conference proceedings and journal papers.

• Why do you care?
  – Scientific writing is a crucial skill for academics and scientists.
  – Scholarly publications report research findings to peers and society.
  – Papers are your contribution to the permanent scientific record.

  *But most importantly,*
  – Your publications are *the* criterion by which your performance as an academic and professional scientist is assessed.
Part I: The Structure of Papers
Taxa of scientific papers

- There are different species of paper:
  1. Theory papers
     - Math, math, more math.
  2. Experimental papers
     - Hardware, experiment, results.
  3. Survey papers
     - Exhaustive report of other people’s work in the area.

All comprise the same parts, just in different proportions.
Anatomy of a paper

• All (good) papers have the following parts:
  – Abstract
  – Introduction
  – Body
  – Results
  – Discussion
  – Conclusion

• Sometimes they are difficult to recognise.
  (But they are always there)

Darwin: Also wrote papers
The abstract

• Arguably the most important part of the paper
  – Also the hardest part to write!
  – Tells readers whether they want to read the whole paper.
  – Most people who see your paper will get no further than the abstract.

• What, why and key results
  – Outline key background and contributions (claims).
  – 2-3 paragraphs at most.
  – This is not a shopping list of things in the paper!
The abstract

**ABSTRACT**

Aerial vehicles are difficult to stabilize, especially when acted upon by external forces. A hovering vehicle in contact with objects and surfaces must maintain flight stability while subject to forces imparted to the airframe through the point of contact. These forces couple with the motion of the aircraft to produce distinctly different dynamics from free flight. While external contact is generally avoided, extending aerial robot functionality to include contact with the environment during flight opens up new and useful areas such as perching, object grasping and manipulation. In this paper, we present a general elastic contact constraint model and analyze helicopter stability in the presence of those contacts. As an example, we evaluate the stability of an off-the-shelf proof-of-concept helicopter system for manipulating objects using a compliant gripper that can be modeled as an elastic linkage with angular reaction forces. An off-the-shelf PID flight controller is used to stabilize the helicopter in free flight, as well as during the aerial manipulation task. We show that the planar dynamics of the object-helicopter system in vertical, horizontal and pitch motion around equilibrium remain stable, within a range of contact stiffnesses, under unmodified PID control.
The introduction

• This is the most structured section of a paper.
• Every introduction contains:
  – Background
  – Literature review
  – Roadmap
• Sometimes they are difficult to recognise.
  (but they are always there)
The introduction

• **Background**
  - Why the work is timely and important.

Unmanned Aerial Vehicles (UAVs) have rapidly evolved into capable mobility platforms able to maneuver, navigate and survey proficiently. A natural progression is to advance beyond simple motion and observation to interaction with objects and the fixed environment.
The introduction

- **Background**
  - Why the work is timely and important.

- **Literature review**
  - ‘Due diligence’ for previous work in the area.
  - Sprinkle with citations, liberally.

Several limited examples of flying vehicles physically interacting with objects have been demonstrated, such as in-flight refueling [1], [2] and the transport of slung loads, both individually and cooperatively [3], [4], [5], [6]. In these examples the interacting object is either not acquired automatically (such as a load attached by a human operator on the ground) or highly structured (e.g. refueling booms with optical markers).
The introduction

- **Background**
  - Why the work is timely and important.

- **Literature review**
  - ‘Due diligence’ for previous work in the area
  - Sprinkle with citations, liberally.

- **Roadmap**
  - Signposts where this paper is going.
  - This is an explicit statement of your claims.
  - Use the *pro forma* “In this paper, we…”

In this paper, we discuss key challenges of grasping from a hovering vehicle and present our experimental platform, the Yale Aerial Manipulator (Fig. 1). A dynamic model of the longitudinal and pitch dynamics of a helicopter with a PID attitude controller is used to determine object mass and placement limits for closed-loop stability and cyclic control saturation bounds. We show both analytically and experimentally (using a PID-stabilized helicopter) that the
The introduction

• Variations include:
  – Introductory subsections for key information or ideas that will be relied upon later, e.g. “1.1 Flight Hardware”
  – Extrapolation of background and literature review parts into entire sections of the paper (ie. a survey paper).
  – Explicit table of contents in lieu of a roadmap (very large journal papers only).

• But, in general, do not vary from the template!
The body

• This is where the substance of the paper is found.
  – Each section builds up the logical chain of reasoning leading to the conclusion.
  – The body follows the course outlined in the roadmap.
  – Stay focused and to the point – tangents are the enemy.

• Almost always the easiest bit of the paper to write.
The body

• Structure of the body varies from paper to paper.
  – No hard and fast rules, but each section should compartmentalise the key ideas being discussed e.g.:
    2. The Underlying Theory
    3. An Intermediate Result
    4. My Cool Idea Building on that Result

*Rather than:*

  2. My Idea is Good
  3. An Unrelated Aside
  4. Random Theory Goes Here
The results

• Results presents the tangible evidence that what you have said in the body is actually true.
  – Use the classic high school ‘lab report’ structure:
  – Data are expected in graph or table formats.
  – Simulations (and sometimes proofs) can also go here if appropriate.
The discussion

• Discussion is analysis of the results, after-the-fact
  – Consider implications of the results with respect to the preceding analysis.
  – Identify potential sources of error.

• The discussion is the logical bridge from the results to the conclusion.
  – No new information is introduced in the discussion – its role is to make sense of what has gone before.
The discussion

• Results and their discussion are tightly bound, and often blend together. That’s ok!
  – Depending on need, there can be numerous discrete analysis-experiment-discussion sets within a paper.
The conclusion

- Bring the paper to a close
  - Briefly describe the activities reported in the paper.
  - Highlight key findings, specific results and ideas – use numbers.
  - Keep it high-level; this is not just a summary of everything you did.

7 Conclusion

We have demonstrated a helicopter UAV-gripper system capable of reliably grasping and retrieving objects under human control. This system exploits the unique performance capabilities of an underactuated, compliant gripper to directly address the particular challenges of helicopter imprecision. The helicopter system was found to exhibit a mean landing error of 64 mm with a standard deviation of 55 mm. The system was able to grasp a variety of objects including blocks, balls, bottles and cylinders, ranging from 160 g to 900 g. The most difficult object could be grasped 67 percent of the time, and the easiest object 100 percent of the time. Load bias disturbances of 0.8 Nm applied to the airframe by the payload were rejected by the flight controller around hover.
Other sections you may see

- **Nomenclature**
  - Takes up significant space.
  - Sometimes the only way to control variable overload.

- **Appendices**
  - A place for anything too unwieldy to go in the middle of the paper
  - Use sparingly! “Unwieldy” is often a good indication that there is a better way of presenting the material.

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**NOMENCLATURE**

- $a_i$, $b_i$, $c_i$, etc. Routh-Hurwitz array elements.
- $a$ Blade lift slope.
- $c_{RD}$ Rotor damping constant.
- $C$ Flight controller transfer function.
- $d$ Center of gravity-tether offset.
- $G$ Translational dynamics poles.
- $F_x, F_z$ Elastic tether reaction forces.
- $F_{GE}$ Ground effect force.
- $F_{RD}$ Vertical rotor damping force.
- $g$ Acceleration due to gravity.
- $H, H'$ Open-loop plant pitch-input transfer functions.
- $H_d$ Closed-loop plant pitch-input transfer functions.
- $h$ Rotor height above center of gravity.
Remember

• Each section is a link in a logical chain
  – Introduction lays the background
  – Body analysis sets out your argument
  – Results validates your argument
  – Discussion reasons about your results
  – Conclusion states your final conclusions

If any text does not serve this purpose, *kill it.*
Part II: Style and Prose
On titles

• Good titles are crucial
  – This is how people will search and index your paper!
  – Titles are the first checkpoint for deciding whether to read the paper or not

• Use common search keywords in your title
  – E.g. “Stability of UAVs Grasping Objects” *rather than* “Flying Vehicles Engaging with Targets of Interest”.

• The title should not overstate the content of the paper
  – E.g. “(Towards/Methods for/Principles of) Grasping with UAVs” *rather than just* “Grasping with UAVs”
On citations

• Citations set scholarly work apart from any other sort of writing.

• Aside from giving credit where due, citations also:
  – Provide context for where your research fits with the work of others.
  – Convince people you’ve done your homework.
  – Provide new resources to the reader, and allow for cross-pollination.

• Cite the papers that support your argument; not just the ‘popular’ papers in your area.
On figures

• A picture speaks 1000 words; make sure those words are meaningful.
• Every figure must be referenced in the text; pretty pictures ‘just cus’ detract from the paper.
• Avoid CAD model hell – no one is impressed.

• For better or for worse, your papers will be judged by the quality of their graphics!
On tone and style

- Scientific writing is formal prose.
  - *Strict* English spelling and grammar.
  - Eliminate contractions, idiomatic expressions.
  - Very high reading levels; PhD vocabularies.
  - Extreme attention to typos and formatting.

- Papers have a style distinct from textbooks.
  - Textbooks are pedagogical and expositionary.
  - Papers are terse and to-the-point – maximum density!
  - “Omit unnecessary words”.
On narrative voice

• First person or third person narrative voice?
  – Rule of thumb:
    When making claims use first person (e.g. roadmap).
    “In this paper, we grasped objects with helicopters.”
    Everywhere else, use third person passive*.
    “Helicopters were used to grasp objects.”

*Use of passive voice is open to debate.
On persuasive writing

• Your goal as an author is to convince the reader.
  – Every section should work to get your point across.
  – The chain of logic must be unbroken beginning to end.

• Seduce the reader with careful writing.
  – Give each paragraphs internal structure and direction: Topic sentence, Supporting statements, Conclusion.
  – Use ‘waterslide clauses’ where one idea flows from the next: e.g. “Ground effect acts as stiffness in a second-order system; the natural vertical dynamics are stable.”
Golden rule

The best way to learn to write good papers is to read lots of good papers
Conclusion

• There is more to being a professional engineer than just driving Matlab well

• You need to communicate effectively, network adeptly, and write convincingly

• Do all these things competently, with good technical skills, and you will have success
Questions

Paul’s Time

Sleep

Work
Tune-in next time for...

Your Soldering is Terrible
(probably)

or

“How I learned to stop worrying and love the flux”

Fun fact: The world record for longest time awake without sleep is 264 hours (about 11 days).