Signals, Systems & Control In the Field!

ELEC 3004: Signals, Systems & Control

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http://courses.itee.uq.edu.au/elec3004/2012s1/

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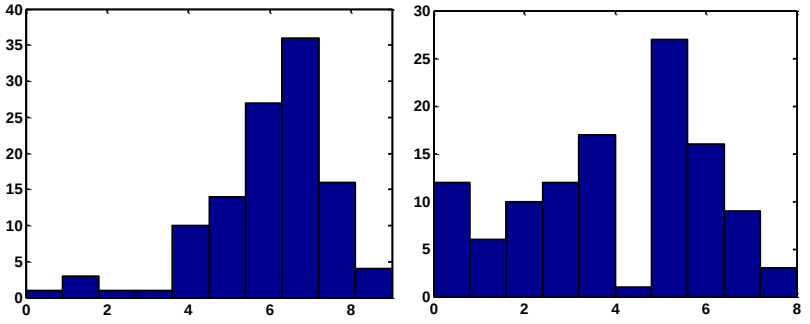
Schedule of Events

Week	Date	Lecture Title
1	1-Mar	Overview
2	5-Mar	Signals & Systems
	8-Mar	Sampling
3	12-Mar	Laplace
	15-Mar	LTI
4	19-Mar	Convolution and Discrete Fourier Series
	22-Mar	Fourier Transform
5	26-Mar	Fourier Transform Operations
	29-Mar	Applications: DFFT and DCT
6	2-Apr	Exam 1 (10%)
	5-Apr	(Guest Lecture from Industry)
7	16-Apr	Data Acquisition & Interpolation
	19-Apr	Noise
8	23-Apr	Filters & IIR Filters
	26-Apr	FIR Filters
9	30-Apr	Multirate Filters
	3-May	Filter Selection
10	7-May	Holiday
	10-May	Quiz (10%)
11	14-May	z-Transform
	17-May	Introduction to Digital Control
12	21-May	Stability of Digital Systems
	24-May	Estimation
13	28-May	Kalman Filters & GPS
	31-May	Applications in Industry

A Little Quiz

On a Scale of 1 (Idiot) -10 (Sevant):

2. Laplace Transforms
3. (Continuous) Fourier Transforms



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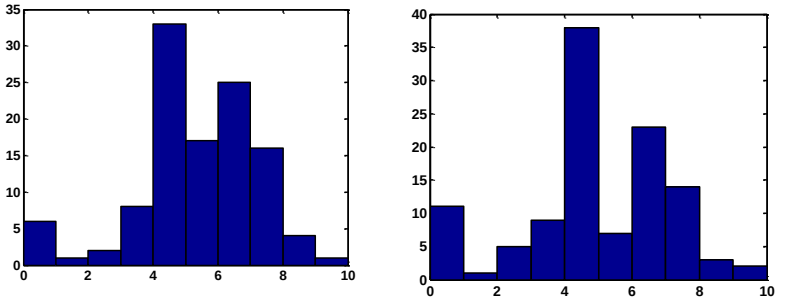
Quiz Results

4. Filters (theory)
5. Filters (implementation)



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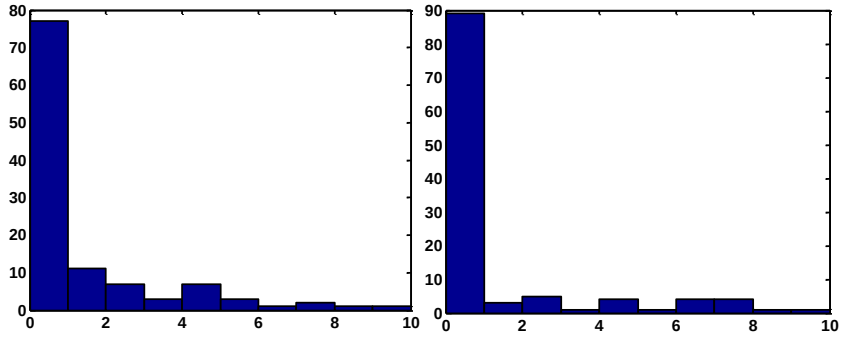
Quiz Results

7. Matlab Signal Processing Toolbox
8. Matlab Control Toolbox



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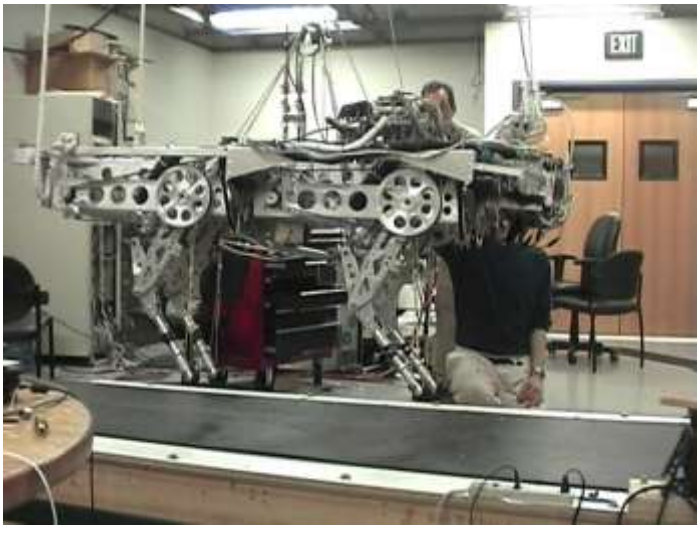
Signals in Locomotion



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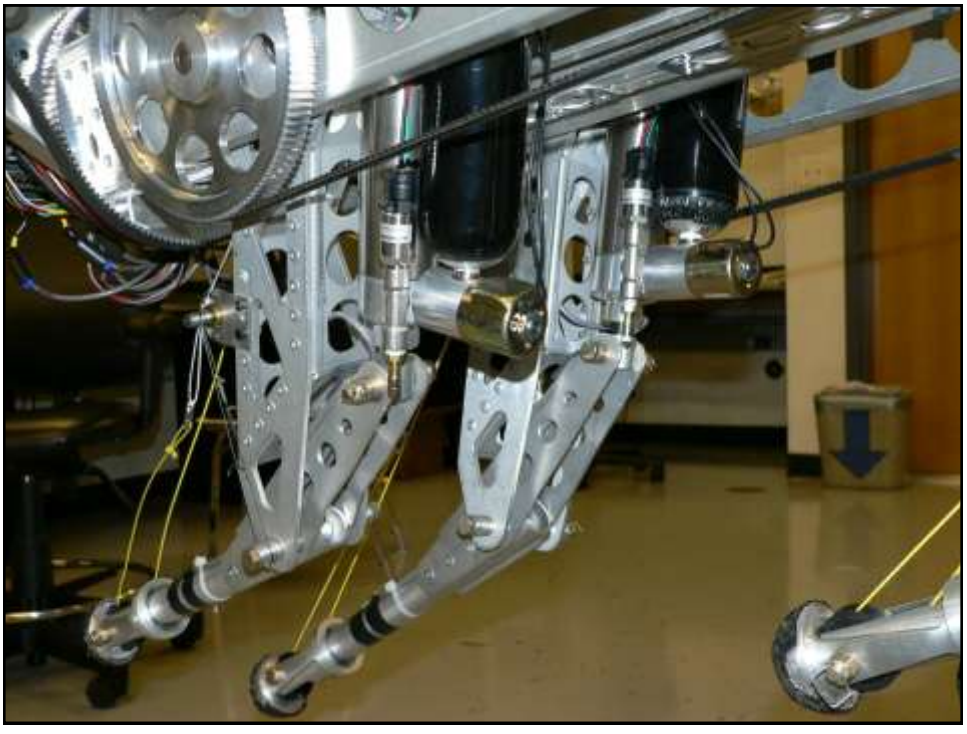
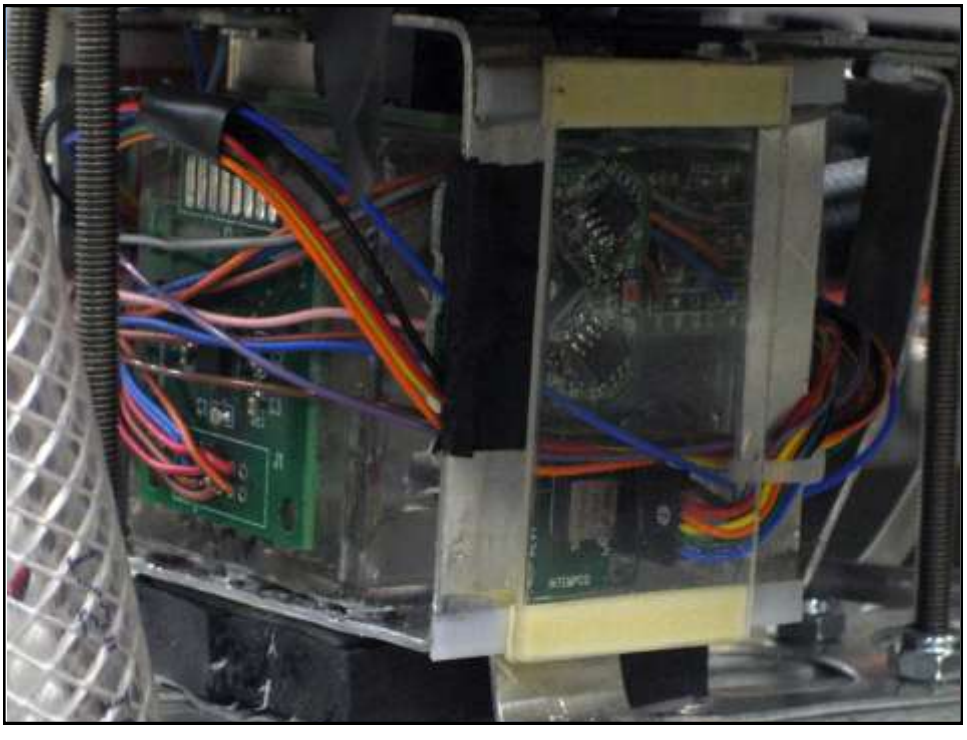
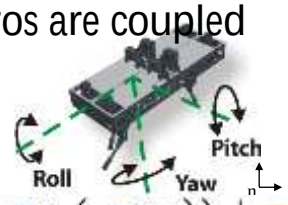




Signals Measured?

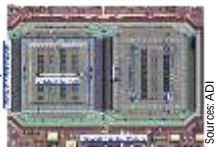
- Rigid Body: Accelerometers & Gyros are coupled



$$\vec{s} = {}^{s}_{o}\mathbf{R}\left({}^{o}_{n}\mathbf{R}\left(\mathbf{a}-\mathbf{g}\right)+\alpha\times\mathbf{r}+\omega\times\left(\omega\times\mathbf{r}\right)\right)\pm\sigma$$

signal (Accelerometer) | rotation | acceleration on $\int dt$ | gravity | $\frac{\partial}{\partial t}$ | tangential | centripeta | Noise

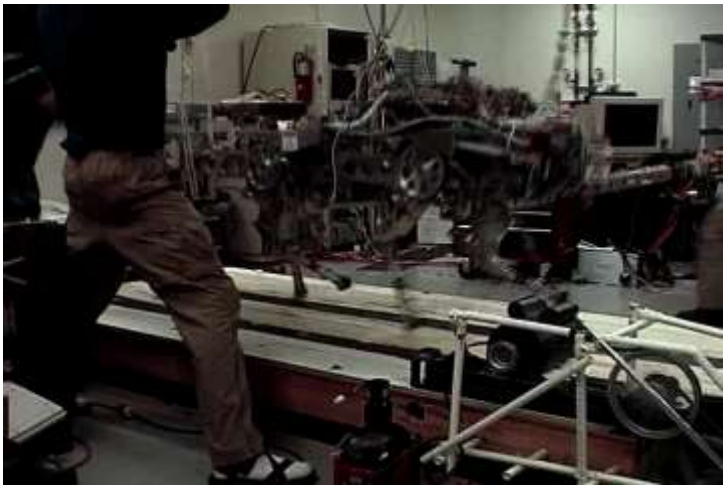
signal (Gyro)



Source: ADI

- Noise adds uncertainty
- Gravitational & inertial forces are inseparable

9

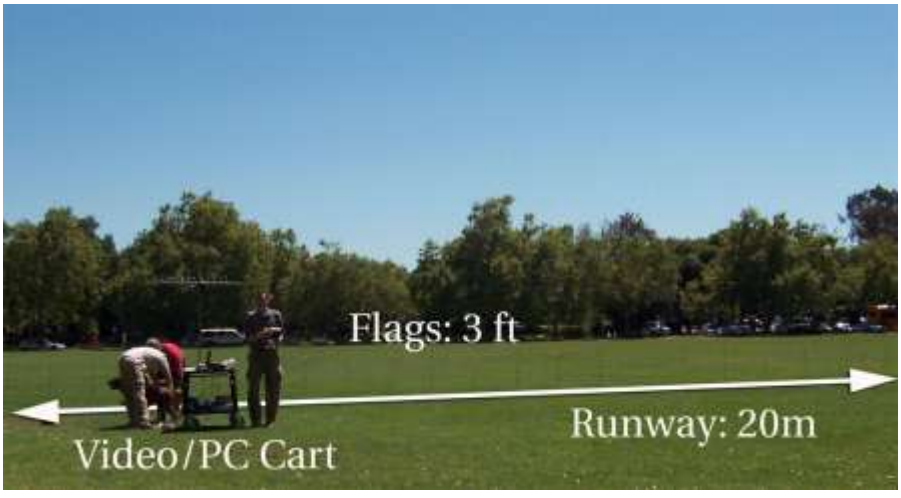


10

Another Quadruped!

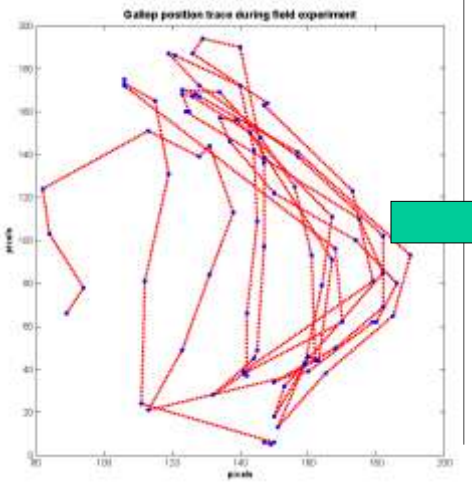
- Chocolate Labrador (*Canis lupus familiaris*)
- 36 kg (80 lb)
- Obedient & trained
- Eats ELEC3004 Homework
- Patient. Very Patient!

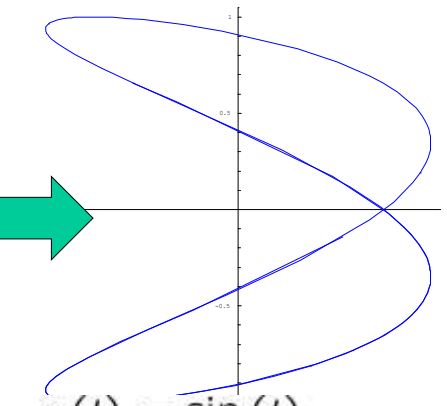
Field Tests



Videographic Results

Lissajous Curves to Visualize Motion Coupling





$$x(t) = \sin(t)$$
$$y(t) = \sin(1/2t - \pi/6)$$

Pitch::Roll=½:1 !!

~±20° Pitch excursion ??

15

Systems & Filters & Controls

- It's Awesome!
- LTI explains a lot ….
  - Suspensions
  - RLC
  - Missile Guidance
  - Hopping Machines
- Controls helps regulate it all
- Estimation helps you find the truth

16

Big Picture Lessons…

- You can always do better
- Why do you say you can't?
- You must invest for the world to invest in you
- Design > Analysis

To Create Something Awesome …

& Systems is a Disciplined Way To Do Just That