Sensor Fusion for Estimating Position of a Legged Robotic Soccer Player

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ROBOCUP 2000

the 4th RoboCup world championships >> melbourne > australia

- Cooperative robots playing soccer
- Legged Robot League
  - Sony Dogs

RoboCup

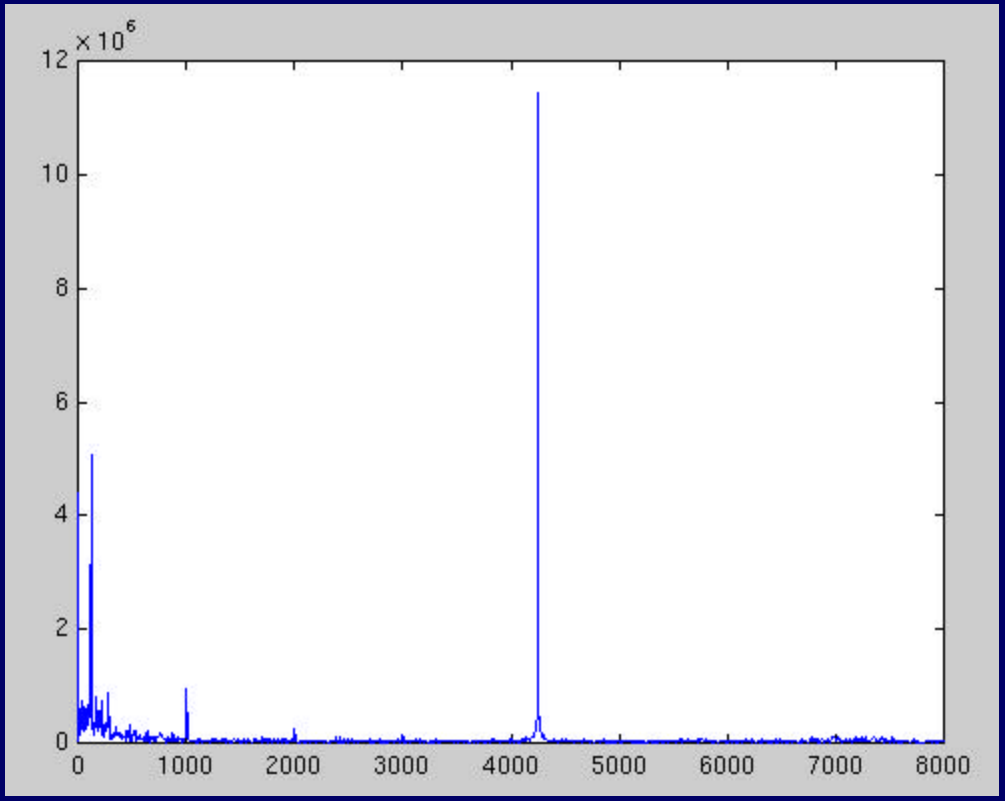
The Robot World Cup Initiative

Problem: Sensors

- Accelerometers and Gyros
- Audio Communication
  - speaker
  - microphone

Frequency Analysis

- Discrete Fourier Transform (DFT) and Fast Fourier Transform



More Frequency Analysis

- Quadrature Detection

$$\left(\left[\sum_{k=0}^{N}\sin(wkT)*f(kT)\right]^2+\left[\sum_{k=0}^{N}\cos(wkT)*f(kT)\right]^2\right)/N$$

N = number of samples
ù = 2ð*f*
f = desired frequency
fs = sampling frequency
T = 1/*fs*

g(t)	g(t) * sin (ùt)	g(t) * cos (ùt)
sin (ùt)	a(t)	0
cos (ùt)	0	b(t)
sin (ùt +ö)	c*a(t)	d*b(t)

Sound

- Examples from Sony
  - playing wave and midi files
  - recording sounds
- Producing tones
  - finding out how sound is produced
  - creating the data needed for the speaker
- Detecting tones
  - noise
  - range

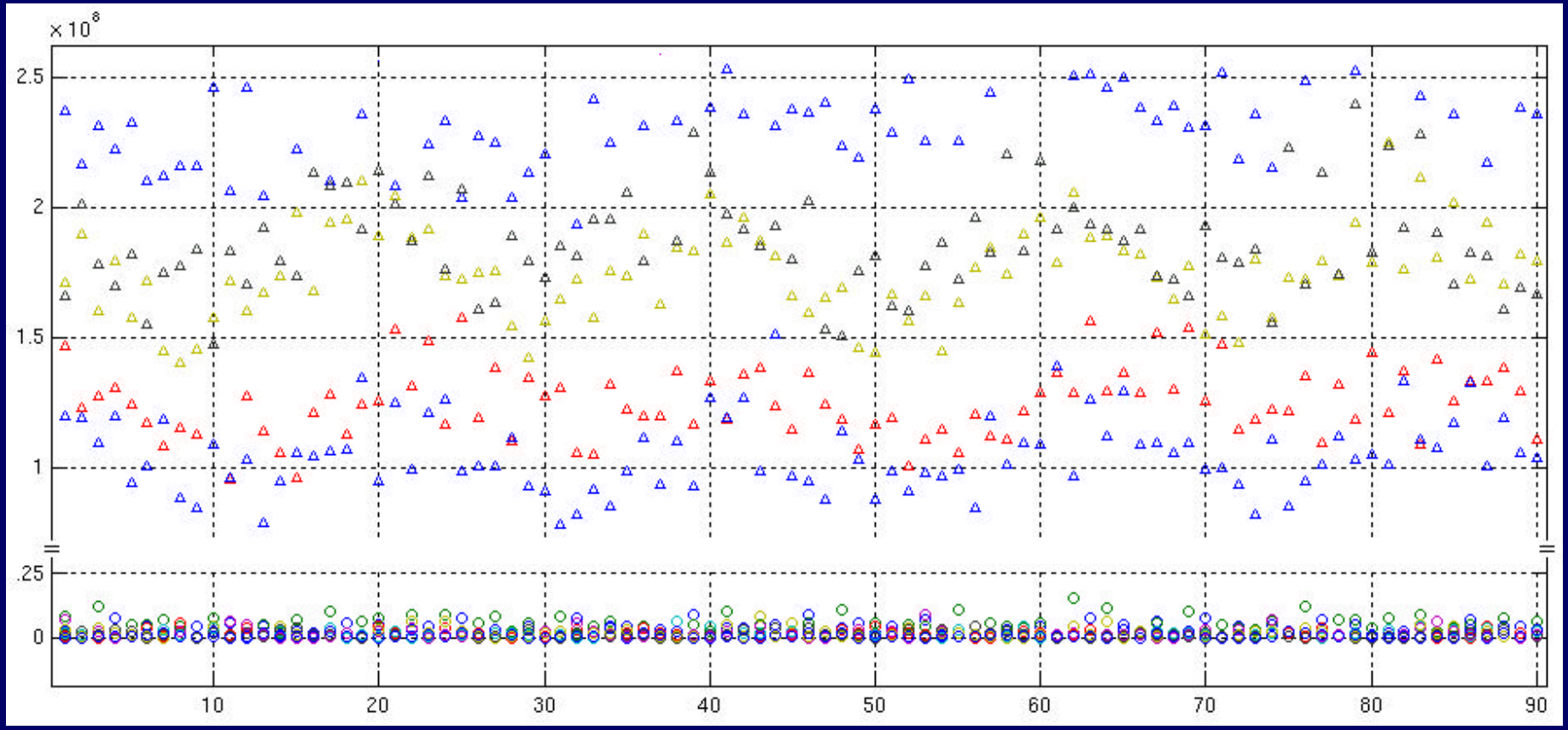
Strategy

- Morse code
- Single frequencies
- Message passing via binary numbers
  - 1 000
  - 1 001
  - 1 010
  - 0 xxx

Implementation

- Quadrature dectection with 64 samples
- Choosing frequencies
- Determining thresholds

Determining Thresholds

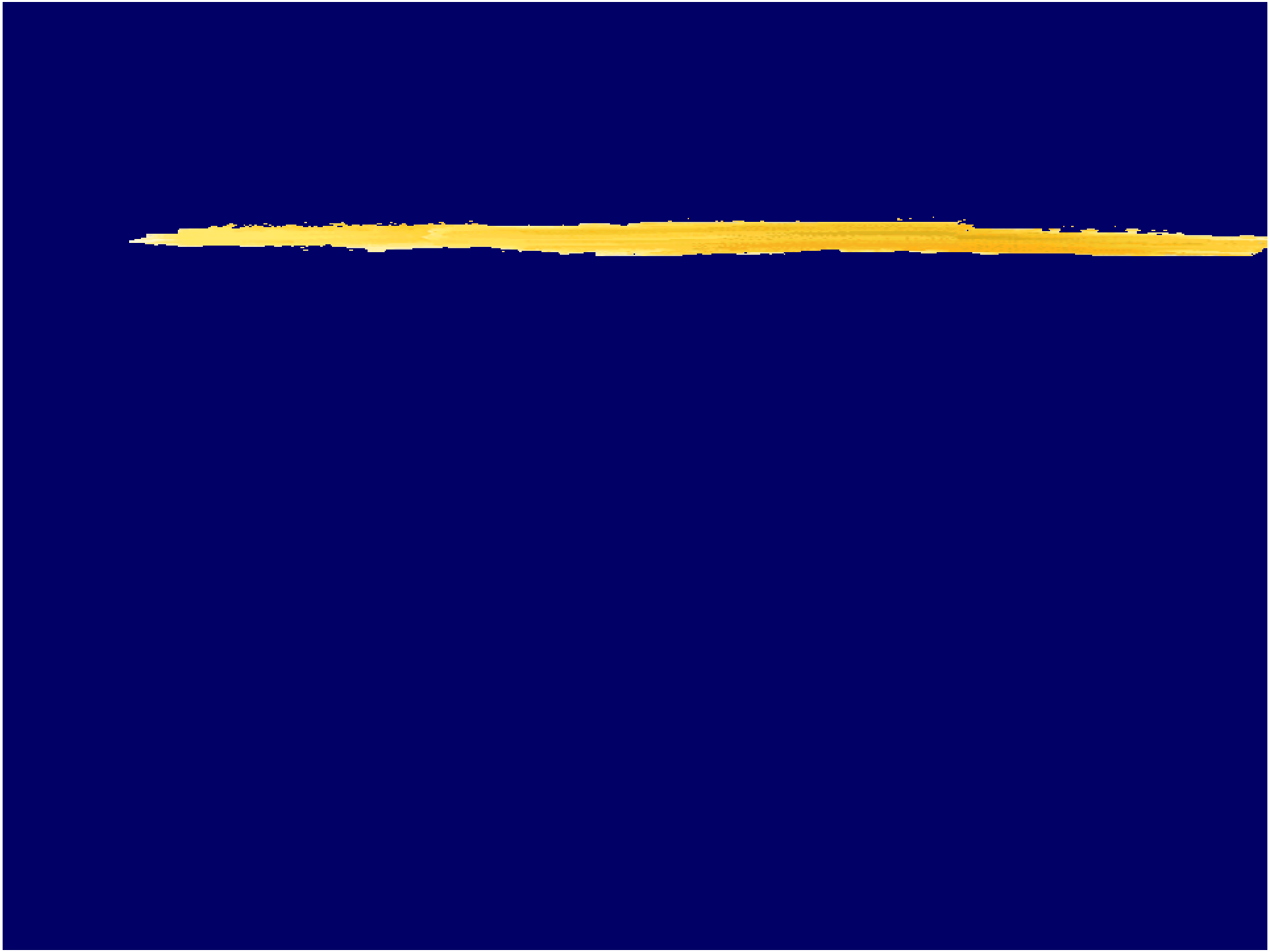


Results

- Software modules
  - producing tones
  - identifying tones
- RoboCup Competition!

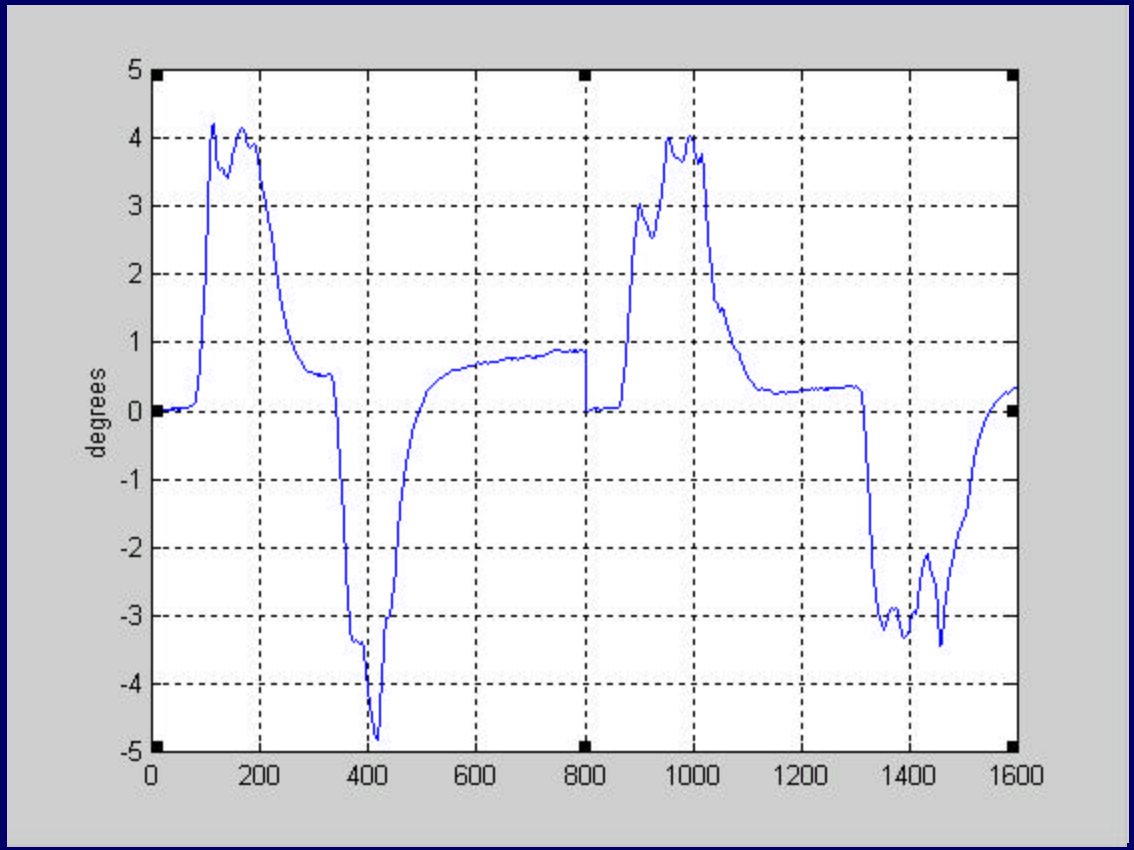
Future Work

- Determining thresholds
- Timing issues with hearing and playing tones
- More messages
  - increase the number of bits
  - no carrier frequency



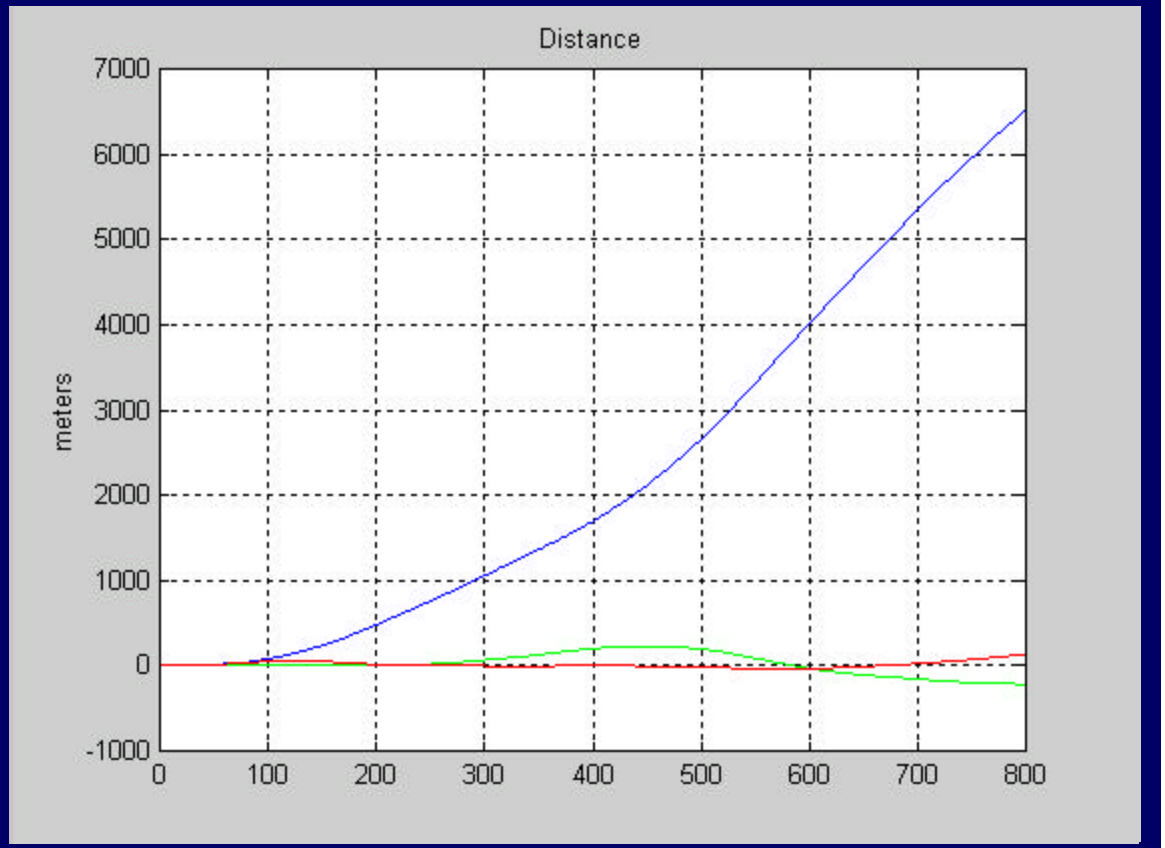
Gyros

- Testing rotation



Accelerometers

- Acceleration, velocity, and distance traveled



Solution

- Implement existing sensor software
- Create and perform experiments to test sensors
  - collect data
  - calibrate sensors
- Data Analysis
- Aperios - Sony’s Object Oriented Operating System