

CUSP -

Canterbury University Strong-Motion Accelerograph Project: an Overview

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Introduction

- CUSP:
 - 12-bit, strong-motion seismograph
 - Low-cost
 - use of micromachined silicon chip - "airbag"- accelerometers
 - Internet-based; convenient for:
 - monitoring state of instrument
 - downloading of records
 - e-mail out on recording earthquake

Motivation

- Imminent rupture of NZ Alpine Fault
 - mean recurrence interval = 250 y ($M \geq 8$)
 - last rupture: 1717 \rightarrow 280 y ago
- High cost of present instruments



Seek to place a network of about 80 instruments in central South Island, to observe:

- rupture mechanism
- regional attenuation
- site effects in Holocene formations beneath Christchurch
- Cost of buying off shelf: $80 * \$US6000 / 0.4 = \text{\$NZ 1.2 million}$
- **too much**



CUSP: Joint project between Civil and Electrical Engineering Departments

Doctoral reasearch project of Hamish Avery

- Two cycles of development
 - CUSP-1: custom-built instrument with,
 - 6-layer printed circuit board (PCB)
 - powerful digital signal processor(DSP)
 - too expensive
 - CUSP-2: DSP replaced by industrial single-board computer, with:
 - reduced risk of component obsolescence
 - solid-state hard disk
 - built-in communications hardware



CUSP-2

Comprises:

- 1) An accelerometer block
 - 3 orthogonal micromachined accelerometers (ADXL105s)
 - 16-bit A/D convertors
 - 2 micro-controllers (for sensor corrections and data buffering)

- 2) A host computer - PII, running under Linux



The Host Computer:

- Controls the sensor (accelerometer) block
- carries out further data correction
- stores data in solid-state hard drive (up to 1024 Mb; 64 Mb standard)
- Acts as web server, allowing:
 - a) Instrument maintenance:
 - b) Data retrieval:
 - e-mail sent on recording of an event
 - records downloaded with Explorer

Web-server functions of PC:

a) Instrument maintenance:

setting and changing of parameters:

- triggering strategy and levels
- communications functions such as e-mail-out address

monitoring instrument state - e.g., temperature
battery voltage, events log

b) Downloading of data.

- e-mail sent on recording of an event
- records downloaded with Explorer

Power supply

- instrument requires 12 volts, 0.75 amps
 - external car-type battery and charger
 - shut-down on low battery; automatic reboot as voltage rises

Timing

- by GPS

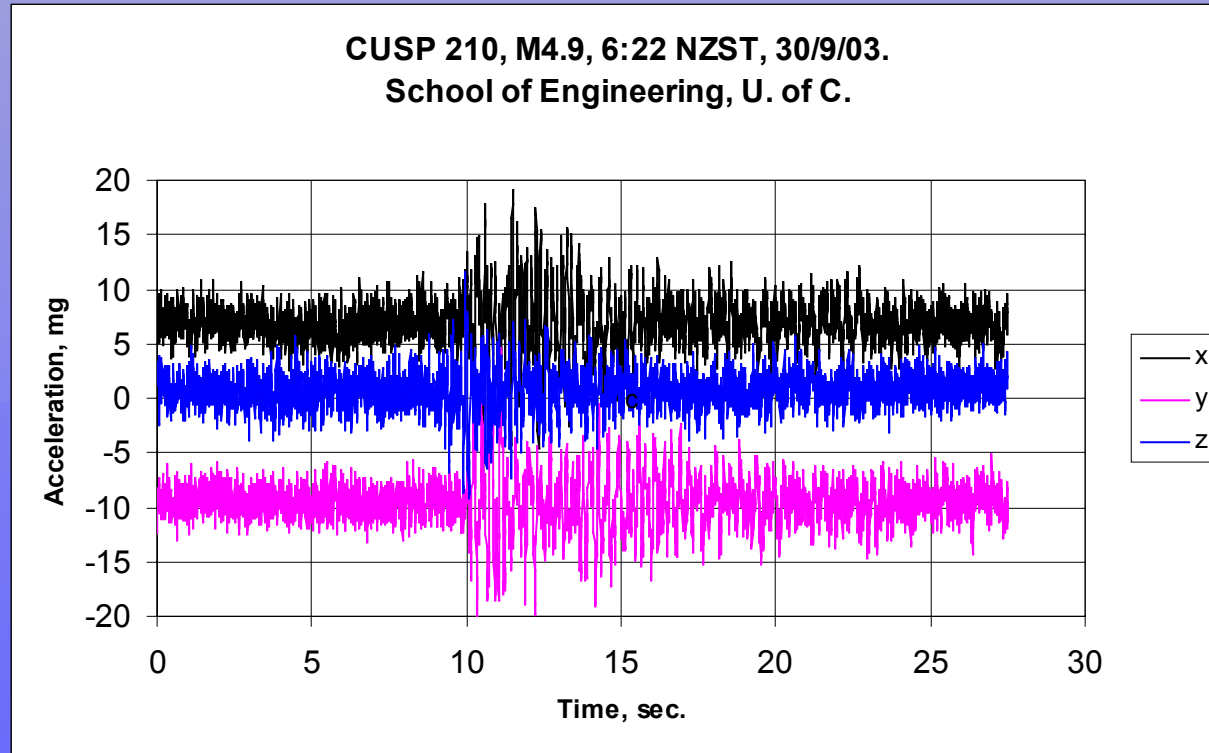
Noise Level:

- 1.7 *mg* r.m.s. or, optionally, 1.0 *mg*



It works!

First real earthquake:
M4.9 at 40 km, 30/09/03



Conclusions

- The low -cost, micro-machined accelerometers appear to give a satisfactory strong-motion accelerograph
- Internet integration achieved, and should lead to low maintenance costs

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