## Mathematics in Industry New Zealand

MINZ +

There and back again

Mark McGuinness Victoria University of Wellington New Zealand



#### MINZ + Mathematics in Industry New Zealand history - connection to MISG problems solved Μ fast heavy fruit Ζ Ν • moisture in bauxite

### Math in Industry Study Groups



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#### MISG

From Wikipedia, the free encyclopedia

MISG may refer to:

- The Mathematics in Industry Study Group, an annual workshop now held in Australia, under the wing of Australian and NZ Industrial Applied Maths ANZIAM
- Malaysian Islamic Study Group, a U.S.-based student organization
- Military Intelligence and Security Group, the former secret police agency of the Philippines

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• mostly in Australia

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Seumas McCroskery



### M I MINZ N Z Mathematics in Industry New Zealand

- June 2015 Graeme Wake Massey, Auckland
- July 2016 Mark McG & Graeme Wake Victoria Uni Wellington
- June 2017 Luke Fullard & Richard Brown Massey, Palmerston Nth
- June 2018 Hyuck Chung & Jiling Cao Auckland Uni of Technology
- June 2019 Richard Clarke & Andreas Kempa-Liehr Uni of Auckland

### M I MINZ N Z MAthematics in Industry New Zealand

Ζ

- June 2015 Graeme Wake
- July 2016 Mark McG & (
- June 2017 Luke Fullard &
- June 2018 Hyuck Chung
- June 2019 Richard Clark

# Real problems

- Academics working with industry
- Inspiring mathematics
- Effective mathematics clear application

## Study Groups

- Real p
- Acade
- Inspírí
- Effect
  applic















• Ensuring continuity into the future





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- Umbrella organisation? ANZIAM, NZMS





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  - KiwiNet are wonderful...
  - \$ required are small

• MISG 2005 in Massey Uni, Auckland (Graeme Wake)

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Compac sort - packing house - 5 to 10 fruit/second

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- conveyor belt load cells

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- still bouncing

- MISG 2005 in Massey Uni, Auckland (Graeme Wake)
- Compac sort packing house 5 to 10 fruit/second
- conveyor belt load cells
- want lgm accuracy
- still bouncing
- not an arcade game (Angry Birds) but has similarities























Compac asked for a mathematical model to save on experiments

power spectra show a low and high frequency the low frequency is lower for heavier fruit it begins to sneak past the filter

#### SIMPLE HARMONIC MOTION & ROCK 'N ROLL



high frequency is due to rocking phase difference sometimes apparent in data

low-pass filter is an issue: lowering the cutoff f slows the filtered signal does not stabilise in time

adaptive filter?

### Outcomes for fast heavy fruit

report written for Compac

- they are redesigning the carriers: one fruit on multiple keys with one weigh point; longer residence times
- Compac came back in 2016 to MINZ at Victoria Uni of Wellington
- Masters thesis on Kalman filter

• Rusal Aughinish: ESGI 2017 at MACSI, Uni of Limerick, Ireland

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bauxite on conveyor belts offloading from ships

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- bauxite on conveyor belts offloading from ships
- moisture increases the weight
- payment is per kg dry bauxite; need to know the moisture %
- microwaves passing through the offloading bauxite provide a measurement every second

### Accuracy Issues

sometimes Rusal's lab results disagreed with microwave results we used polarisation theory and Maxwell's equations we checked the calibration of the microwave setup for moisture <12% we found reasonable matches to lab results with our calibrations

Accuracy Issues



- after the ESGI, a very wet shipment came in
- mícrowave results díffered from lab measurements by >4%



TaiPrizeData Projected phis after rescaling



TaiPrizeData Projected phis after rescaling



#### Outcomes

- Rusal are not buying more microwave analysers
- we alerted Rusal to signal to noise issues for very wet case
- paper submitted to MICS 2019
- percolation theory for wet bauxite?



· John & Hilary Ockendon to Australia, NZ, 1984



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Study Groups proliferating



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  - ~ in the Pacific, in Europe, all around the world



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  - ~ in the Pacific, in Europe, all around the world
- cooking crispy cereals in 1996 in Melbourne, to Norway last year, & to here in Valencia with many journeys between



# Thank You!