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# SENSING OF WATER SURFACE PATTERNS USING KINECT

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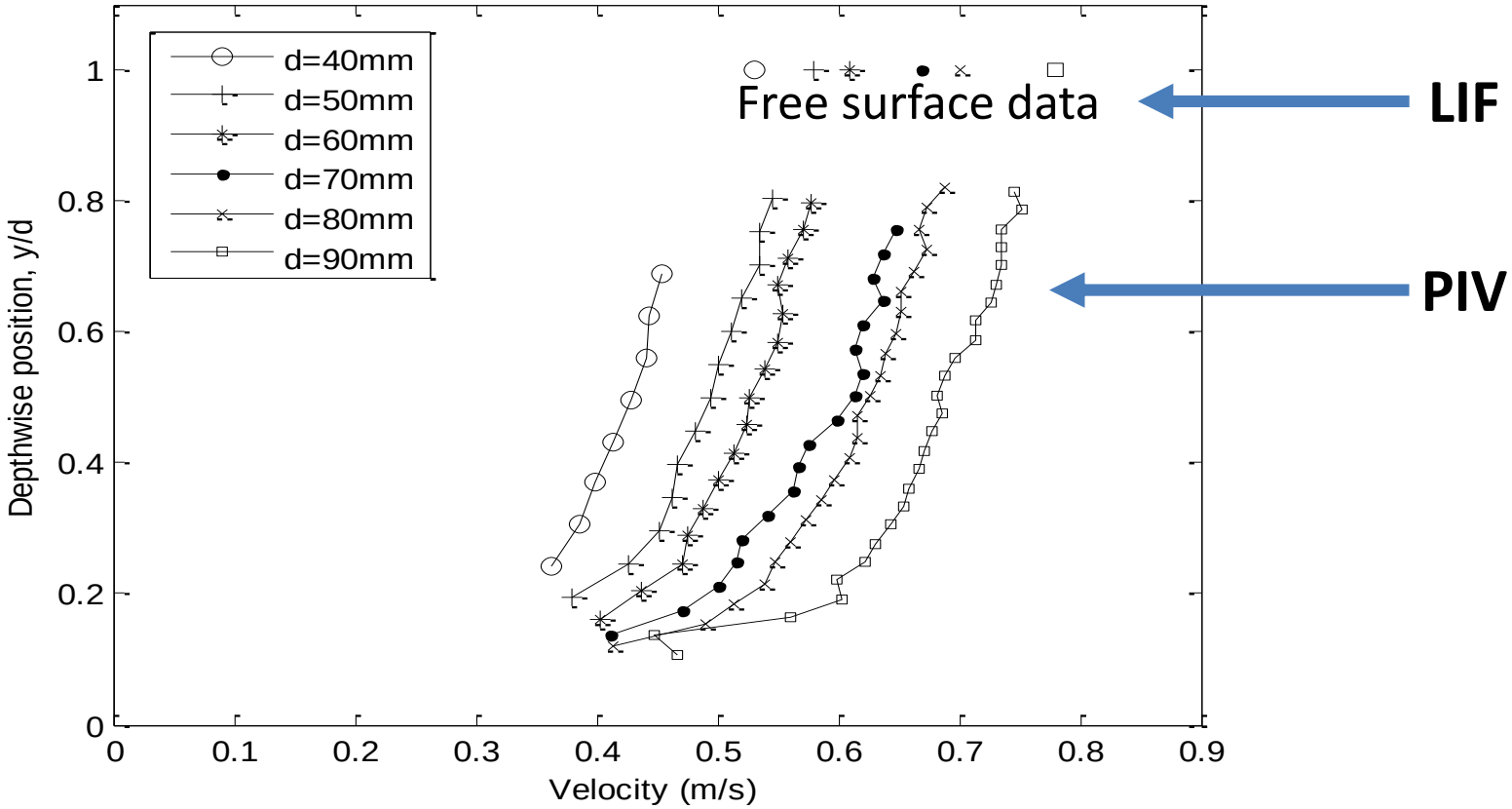
# Introduction

The University Of Sheffield.

**Imaging techniques have been shown to be capable of capturing surface velocity field..**

*(with good lighting, and perhaps seeding)*

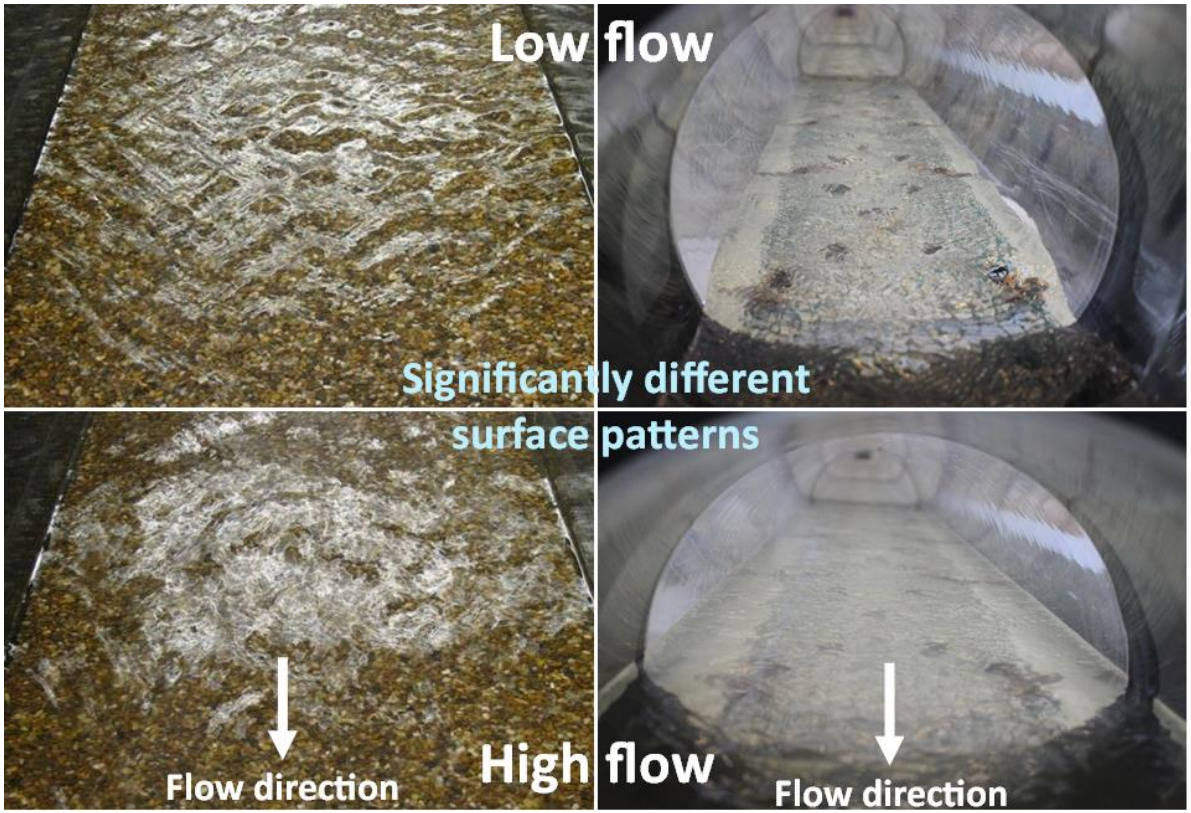
# Introduction




**Which relates to mean flow velocity…**

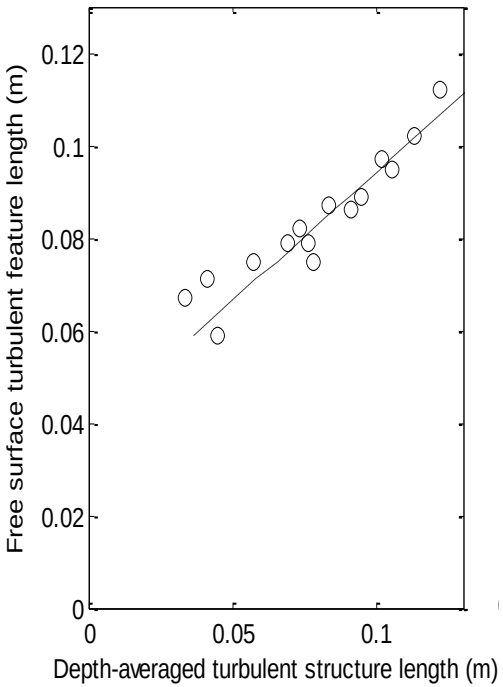
*(assuming a velocity profile/ratio)*

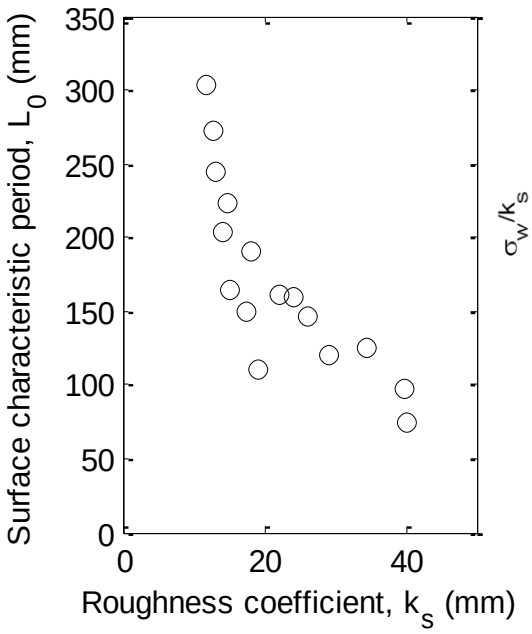
# Introduction

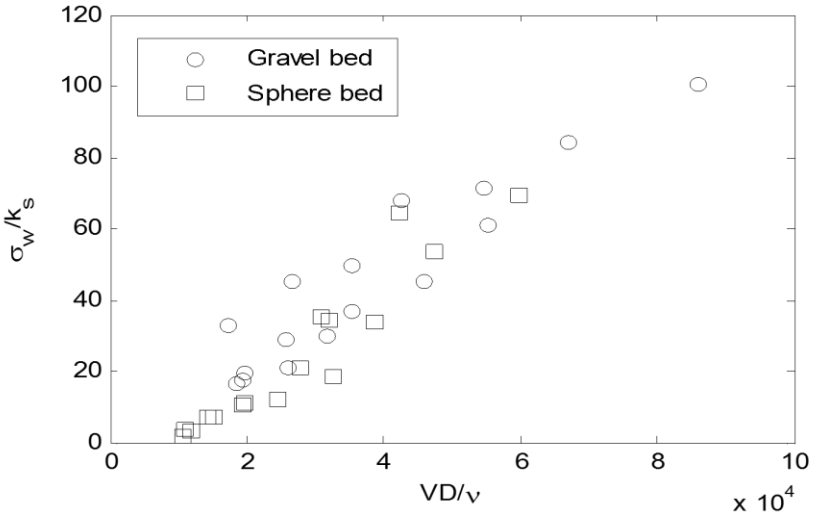


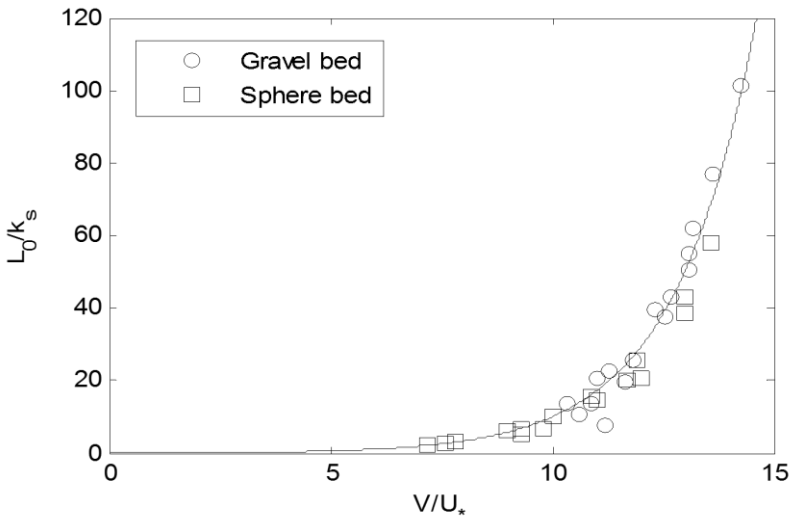

**But we believe the free-surface pattern (fingerprint) can tell us much, much more…**

# Introduction



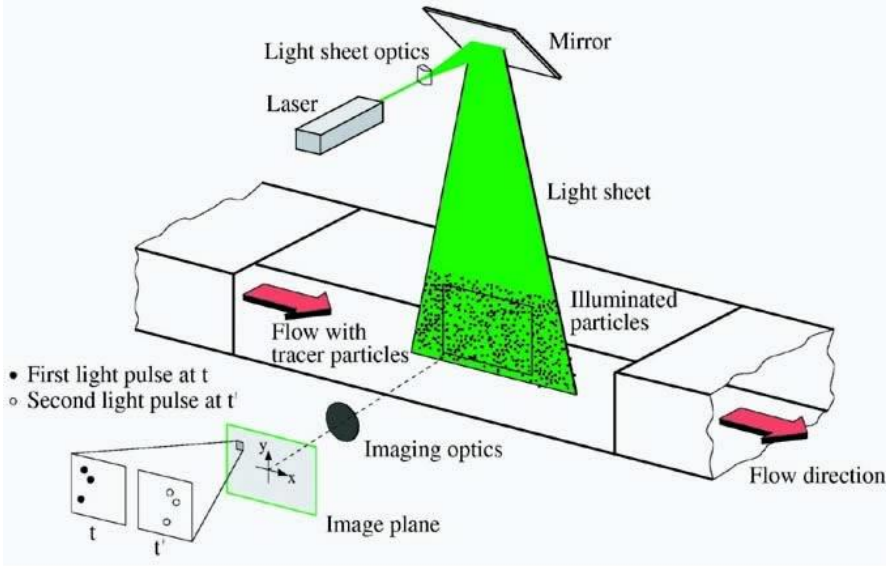




**… such as turbulence length scales, hydraulic roughness, shear velocity, Reynolds number, etc…**

# Introduction

**However:**

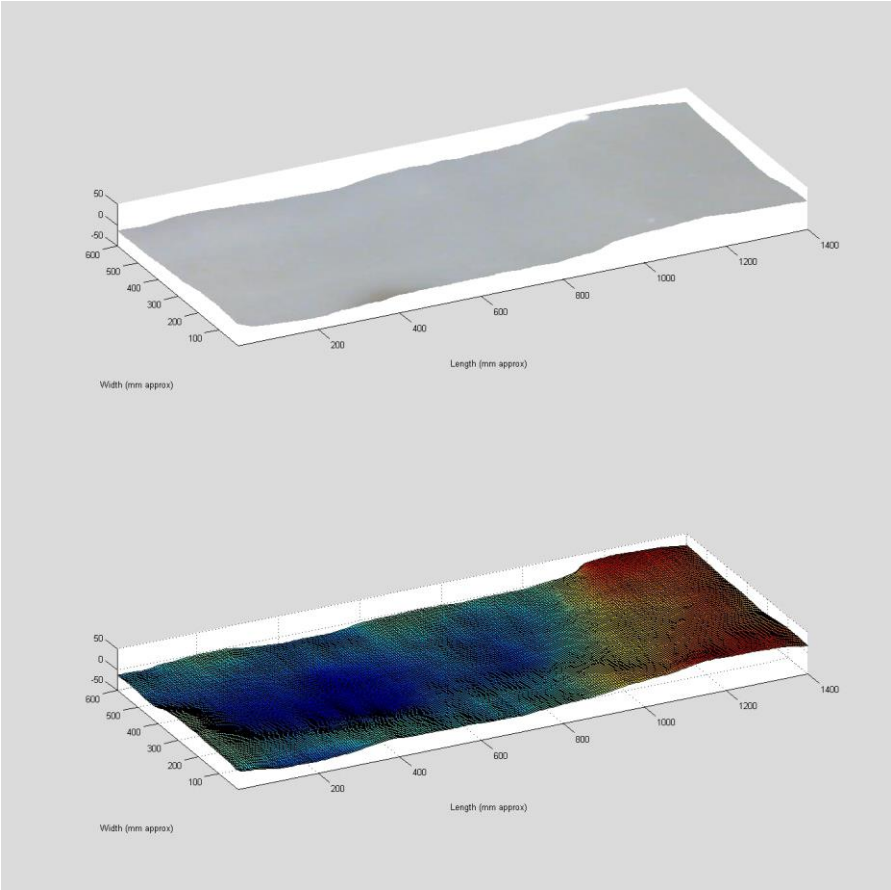
Most surface measurements are 1D/2D, and too costly for mass field deployment.



# Methodology

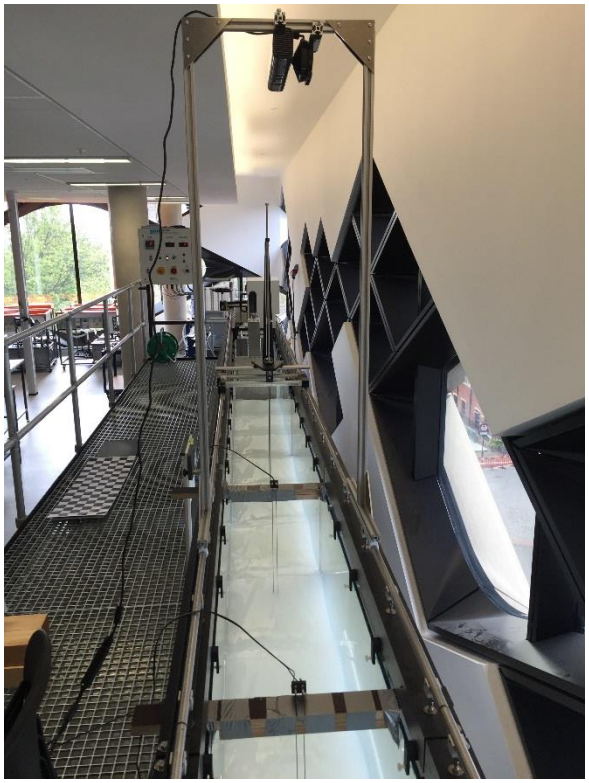
Microsoft Kinect sensor

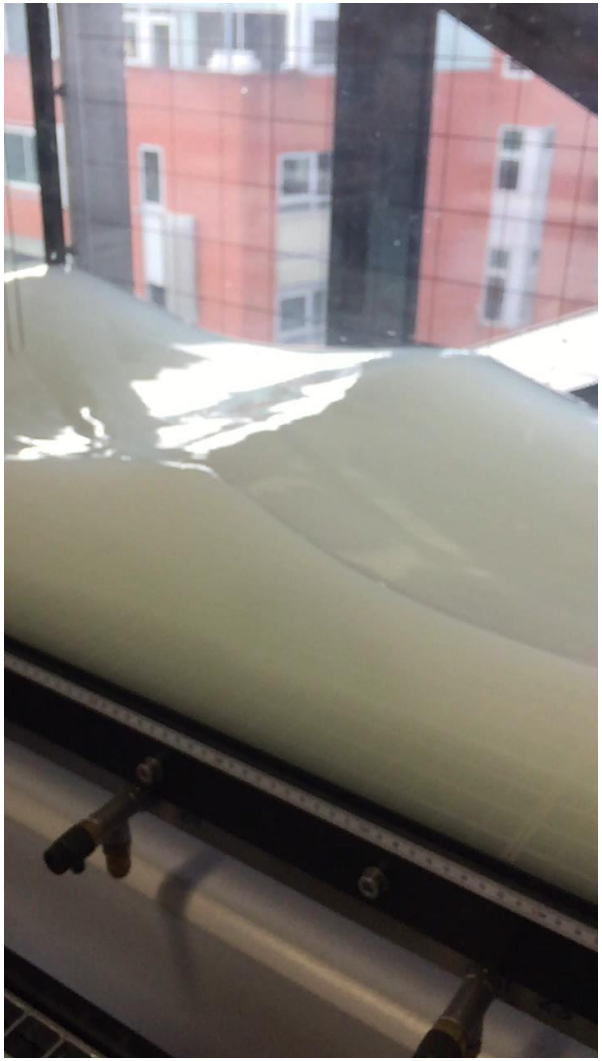
480x640 RGB and Depth




Used before for large coloured waves in wave tank. Nichols & Rubinato (2016) suggested use for turbulence waves.

# Methodology



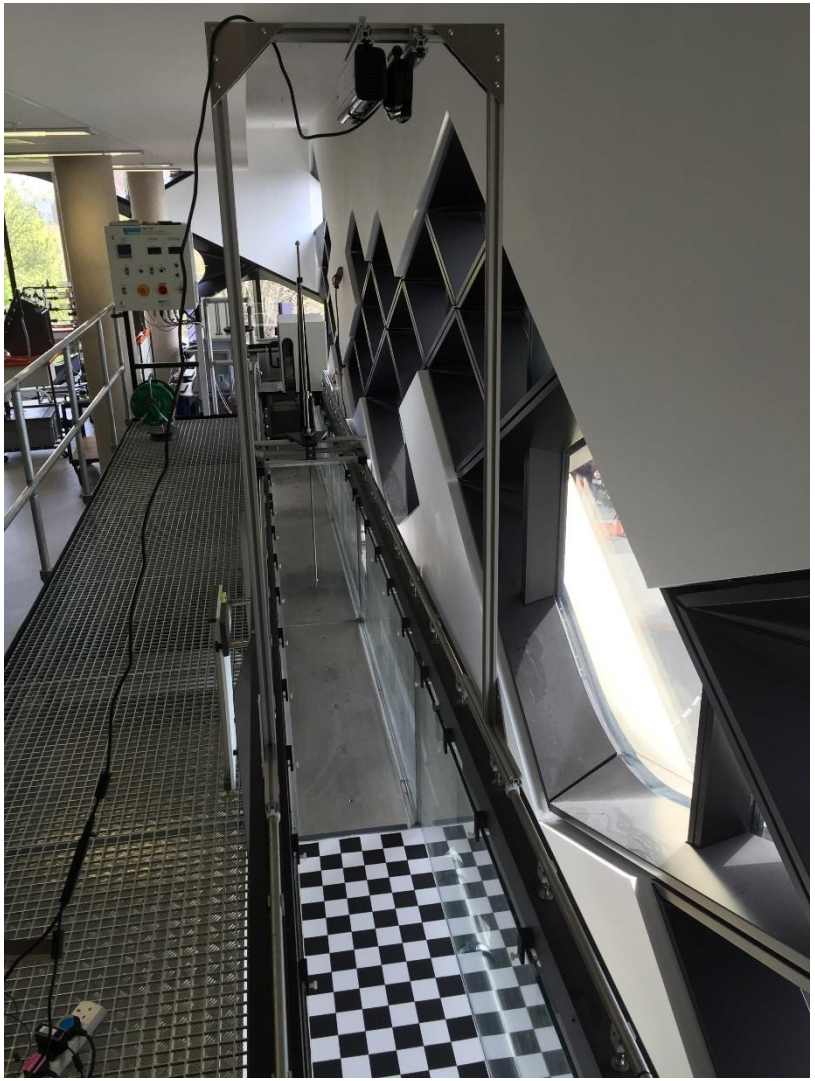


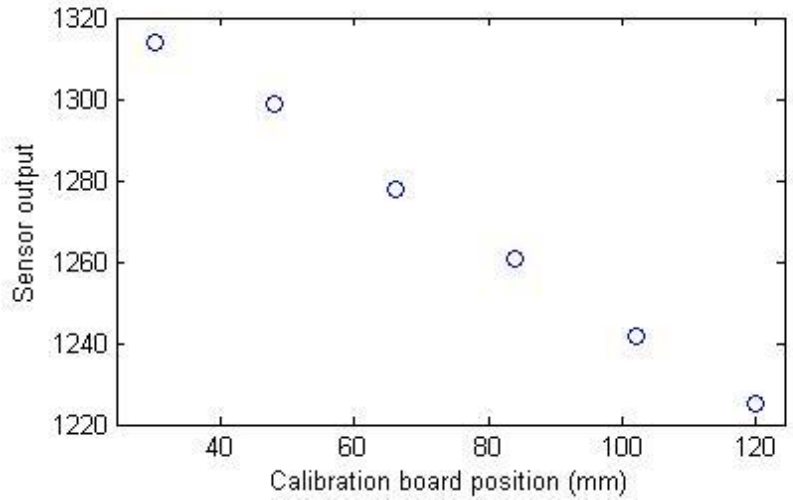
Microsoft Kinect sensor
Wave probes
Colourant: 1% milk
Wave generator (x54)
Flow turbulence (x6)

# Methodology

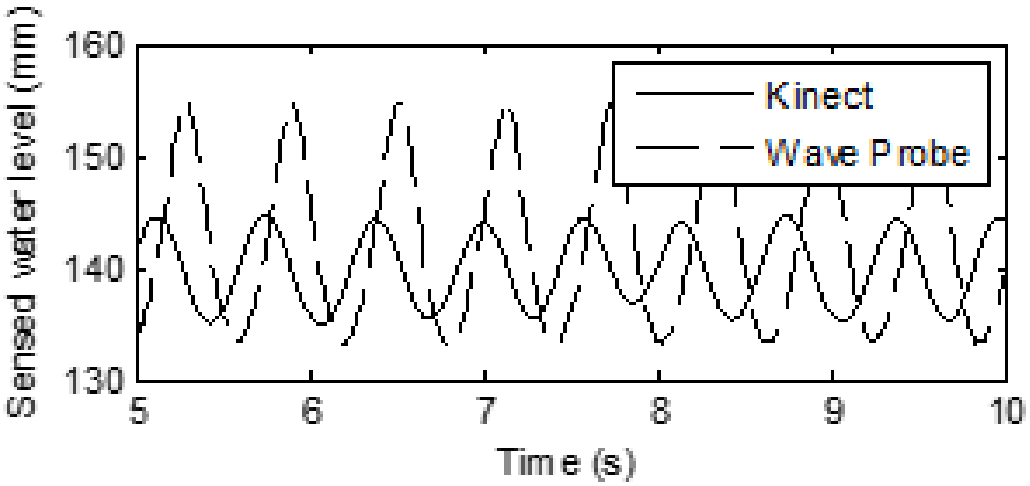
Spatial calibration

Depth calibration

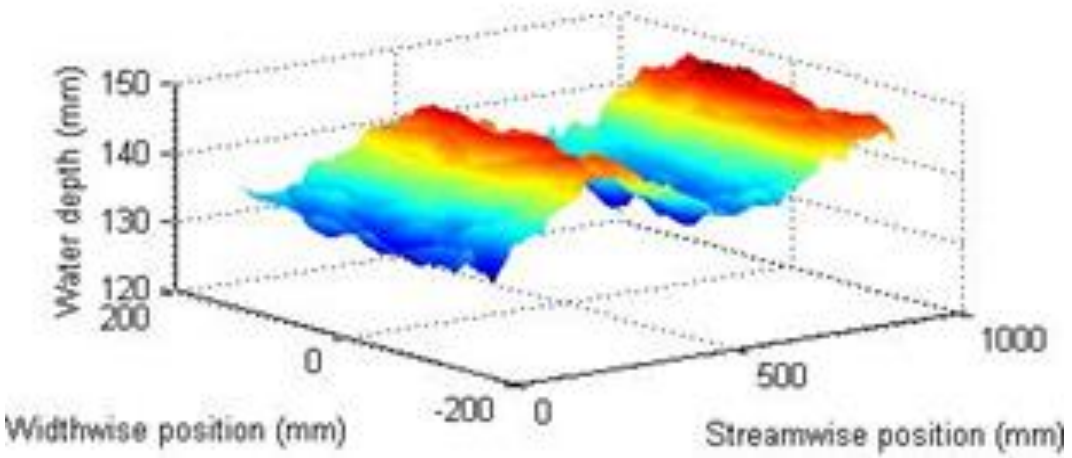




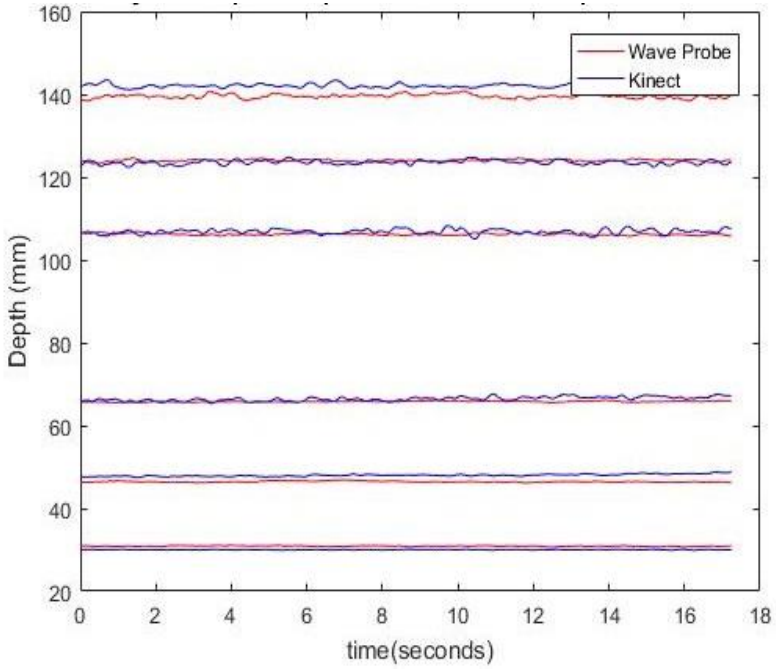
# Results: Gravity wave data



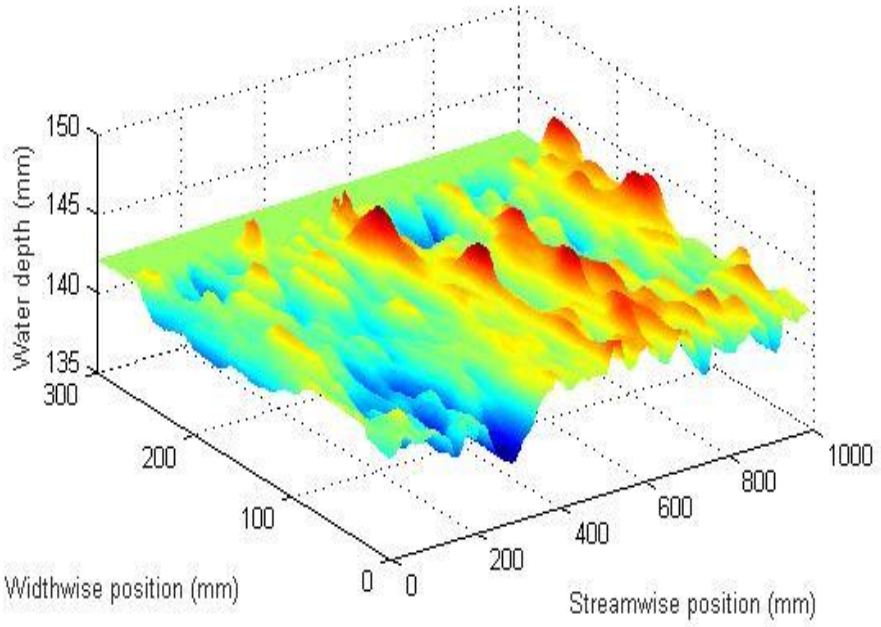

- Similar mean level
- Similar frequency
- Phase difference (lag)
- Lower amplitude
- True for 54 different gravity wave conditions



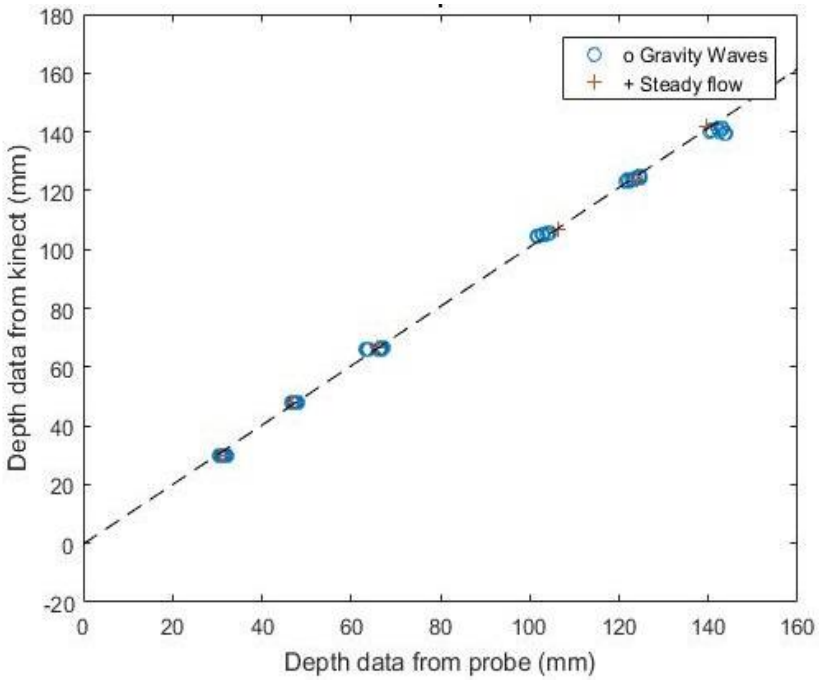
# Results: Turbulence-generated waves

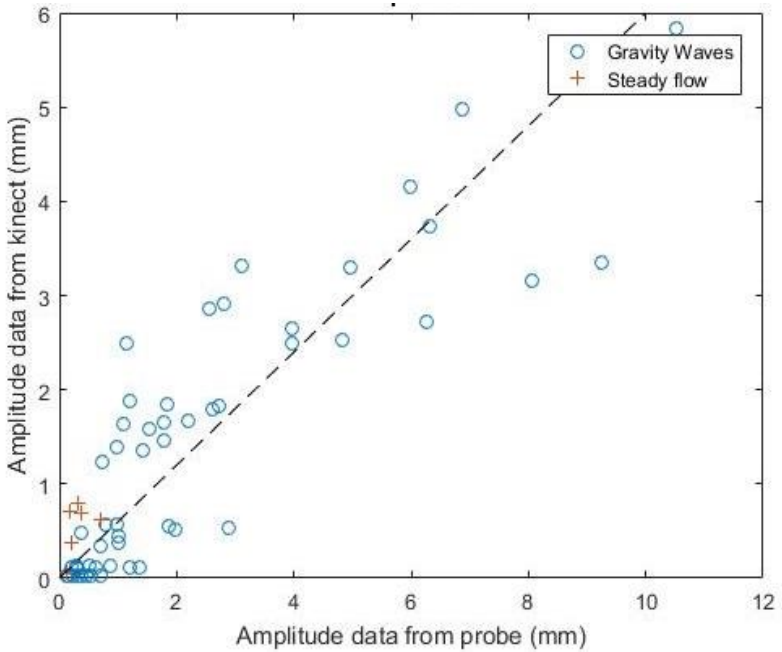



- Similar
- Need detailed comparison



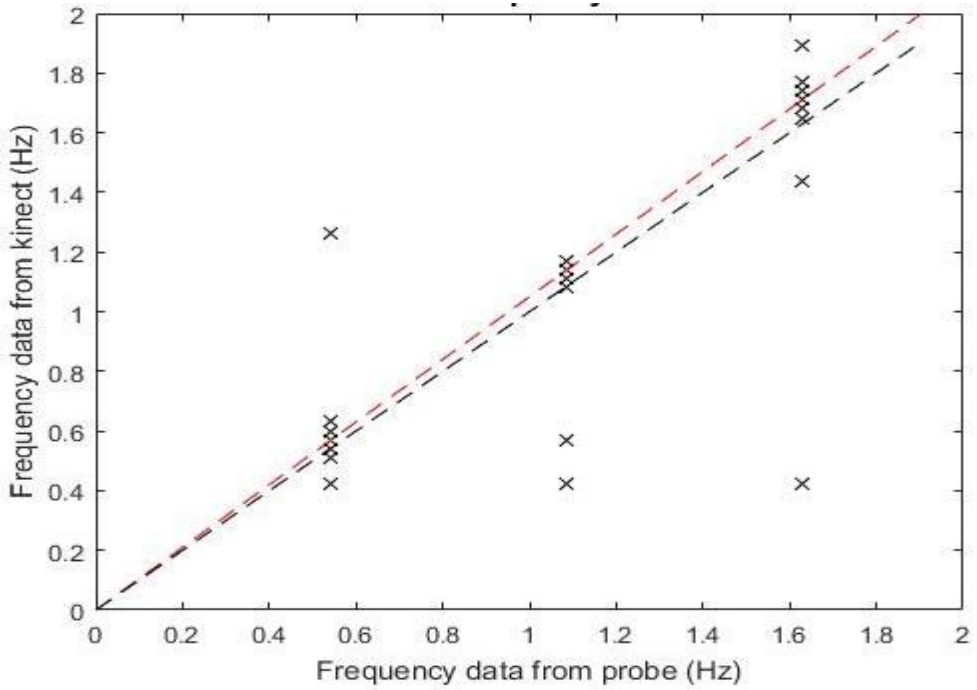
# Results: Mean depth and wave amplitude



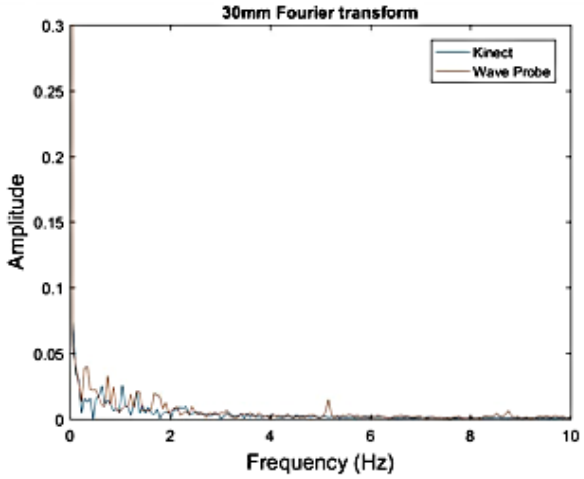

- Mean level is good
- Amplitude is lower but related

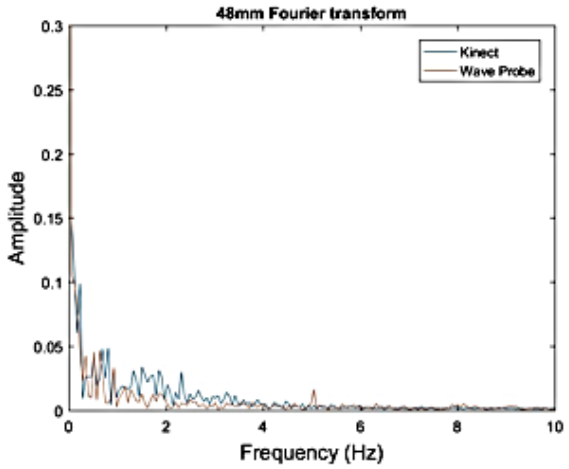
# Results: Gravity wave frequency

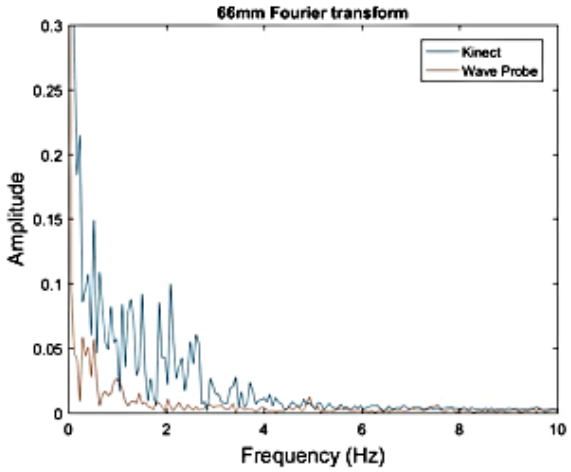


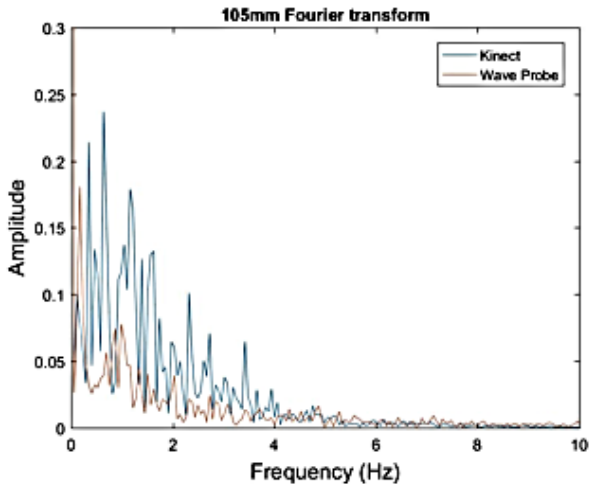

- Mostly similar frequencies
- Though specified as 30 Hz sampling rate, Kinect actually samples at a varying frequency between 25.9 and 31.9 Hz.

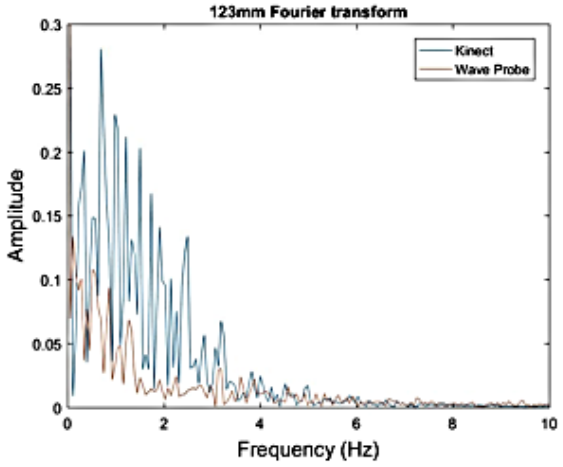
# Results: Turbulence-generated wave frequency

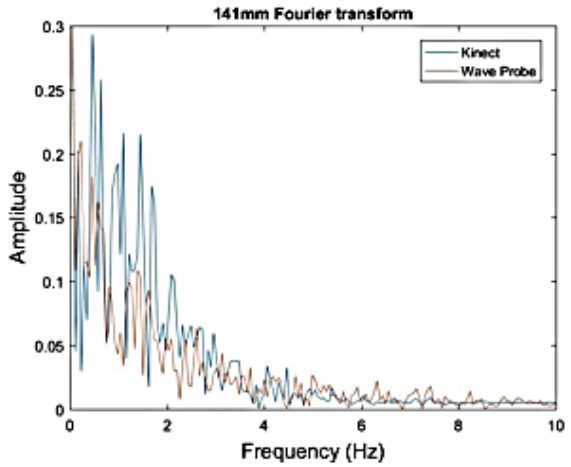


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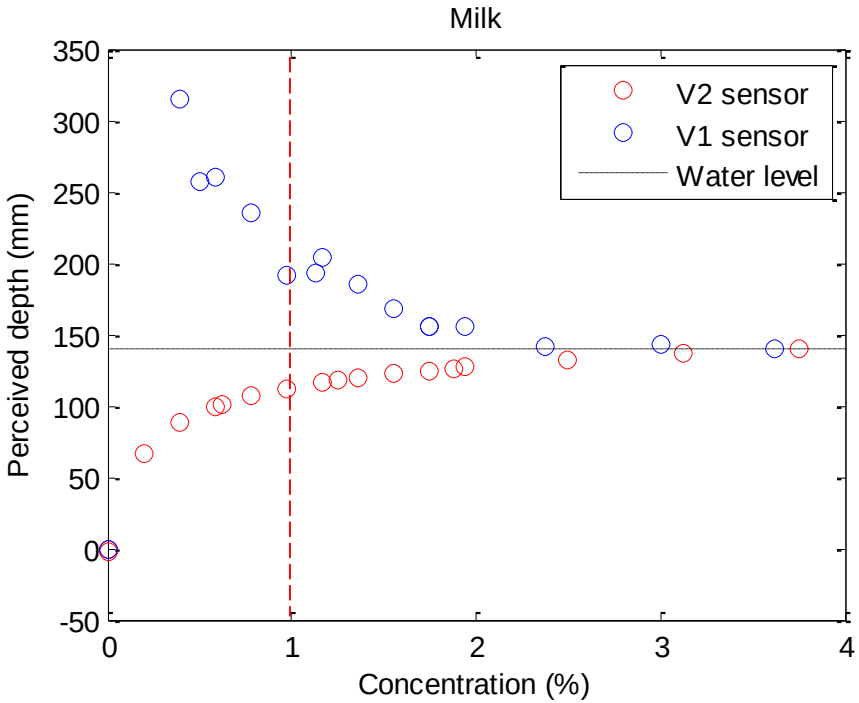
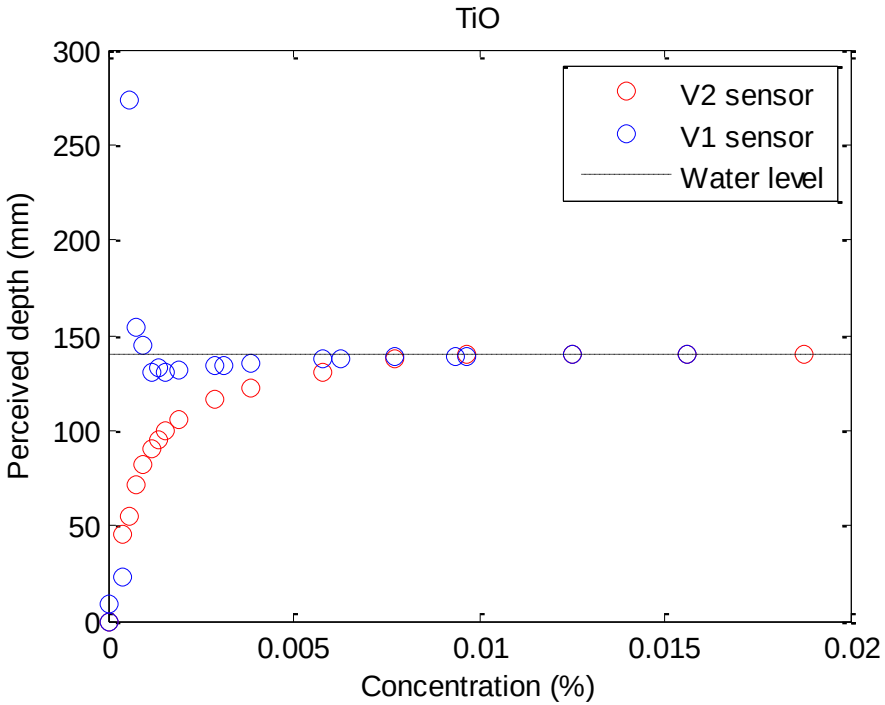
# Evaluation

- Check threshold concentration
- Check stability over time
- Try new colourant (TiO)
- Try new sensor (Kinect V2)

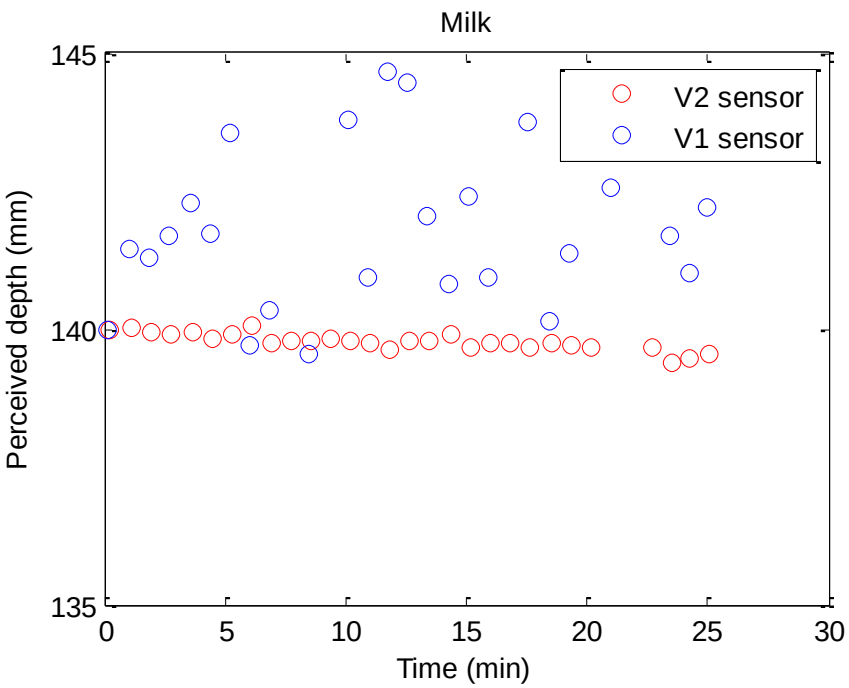
# Evaluation: Concentration threshold

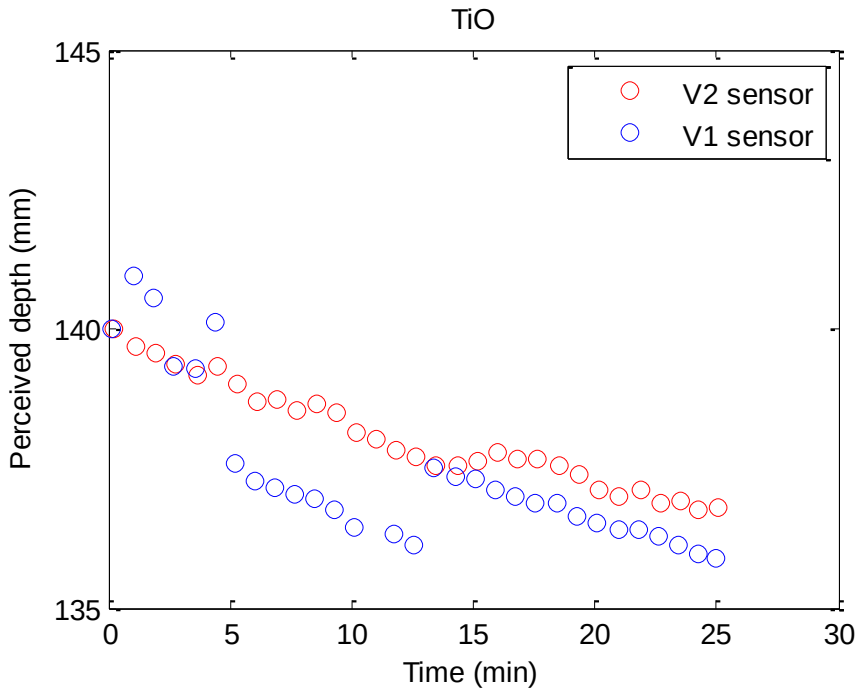



- 1% Milk was too low in this case
- TiO requires much lower dosage
- V2 sensor more reliable?

# Evaluation: Stability over time




- V1 sensor very unstable with milk
- Bother colourants settle over time, TiO more

# Conclusions

- V1 sensor can be unstable → repeat experiments using V2 sensor
- Milk threshold appears to vary from sensor to sensor → check threshold for each sensor prior to testing
- TiO requires lower dosage → further comparison required.

- **Ultimately, this technique can allow remote measurement of free-surface pattern, and hence the underlying turbulence field and flow processes.**
- **Can it be used in clear water?**
- **Can our algorithms be applied to LSPIV camera data?**

Image via http://blogs.msdn.com

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