Research Highlights 2021-22
Wireless Research Centre
University of Canterbury

Dr Graeme Woodward

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CHRISTCHURCH NEW ZEALAND

Outline

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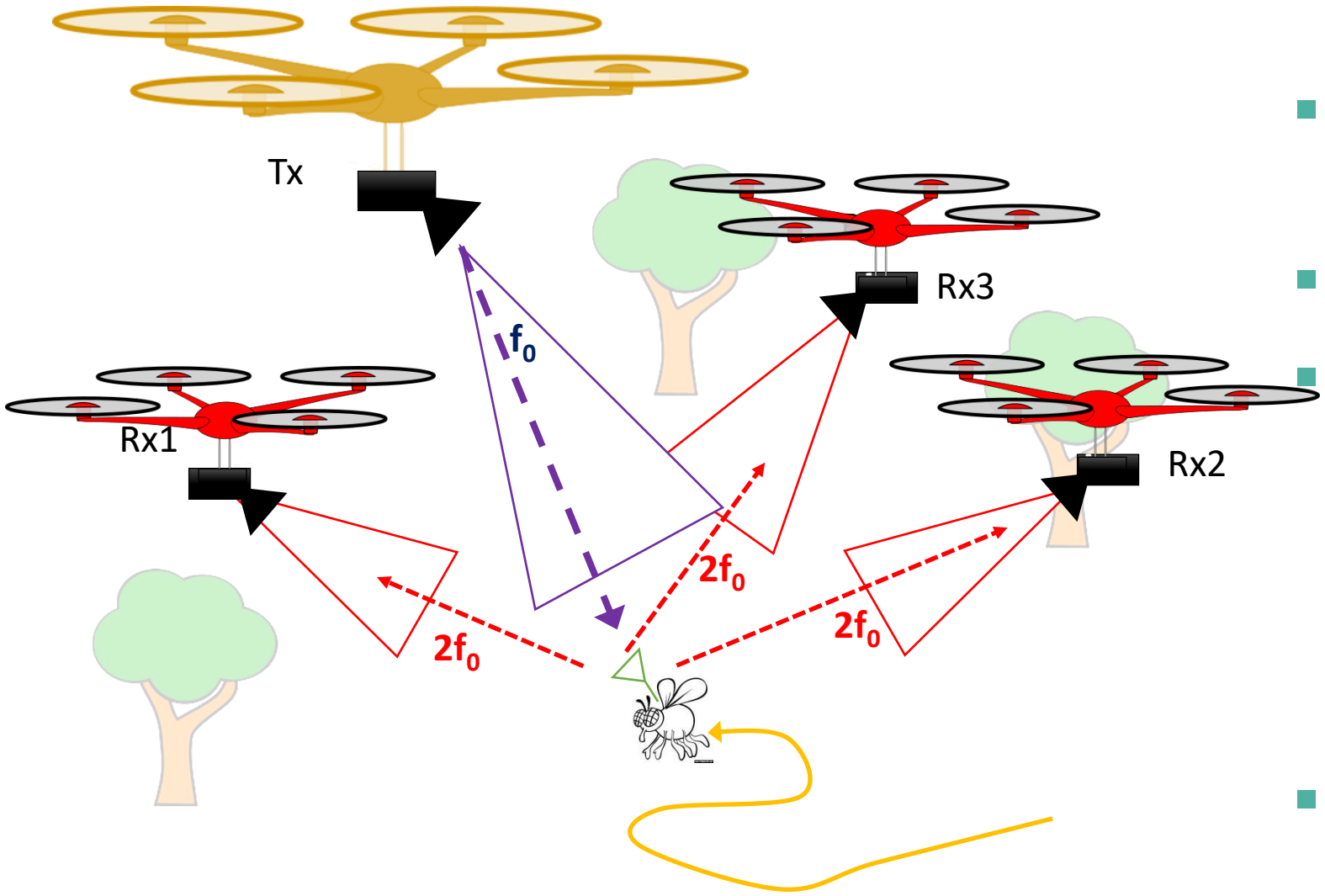
- Radio localisation of insects from drone swarms
- Antarctic sea-ice measurement
- Race Ranger
- mmWave channels

- Postgrads

Multi-static harmonic radar on UAV swarm platform



- One high-power tx @ f_0
- Tag converts f_0 to $2f_0$
- Multiple receivers @ $2f_0$, target position by time difference of arrival + triangulation.
- UAV swarm “moves” with the target

Tag Design [K.Eccleston, Lincoln Agritech]

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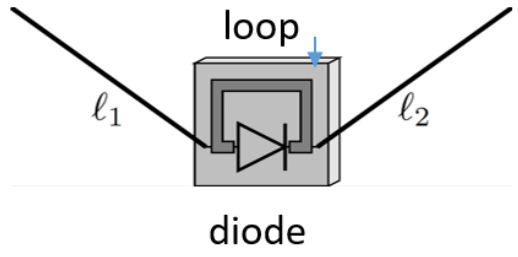
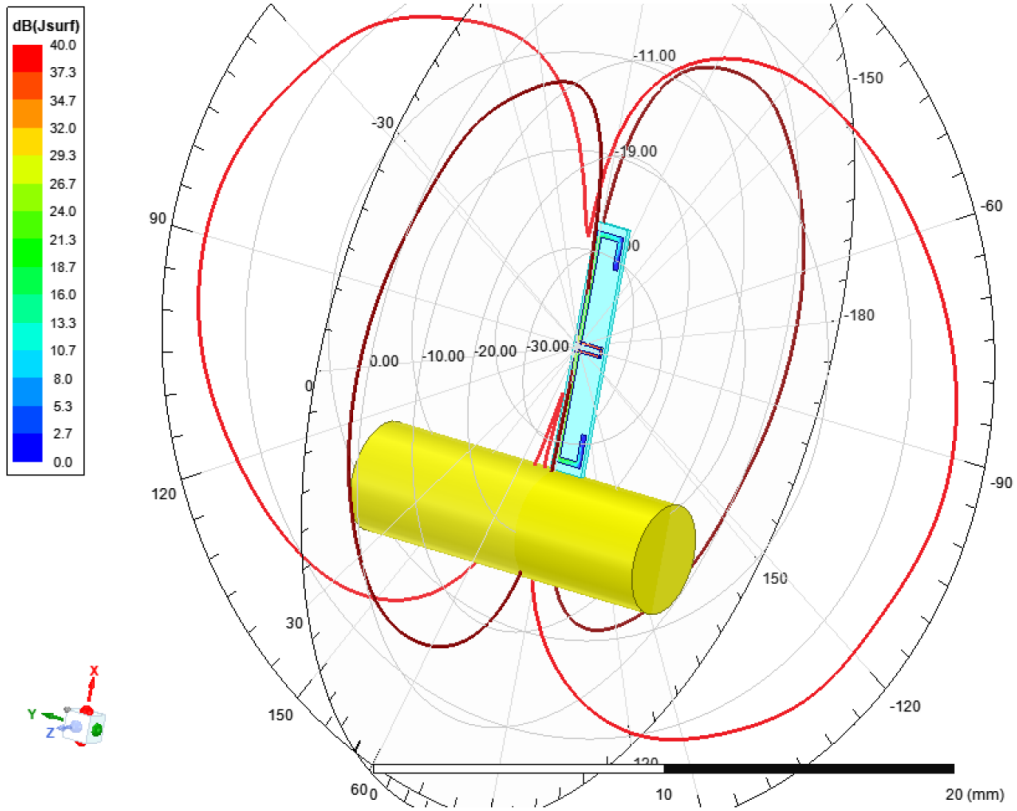
The basic principle of the tag circuit:



- Use photolithography to fabricate tag on 100micron glass.
- Unpackaged beam-lead diode
- Model Anysys HFSS, with model of insect body.

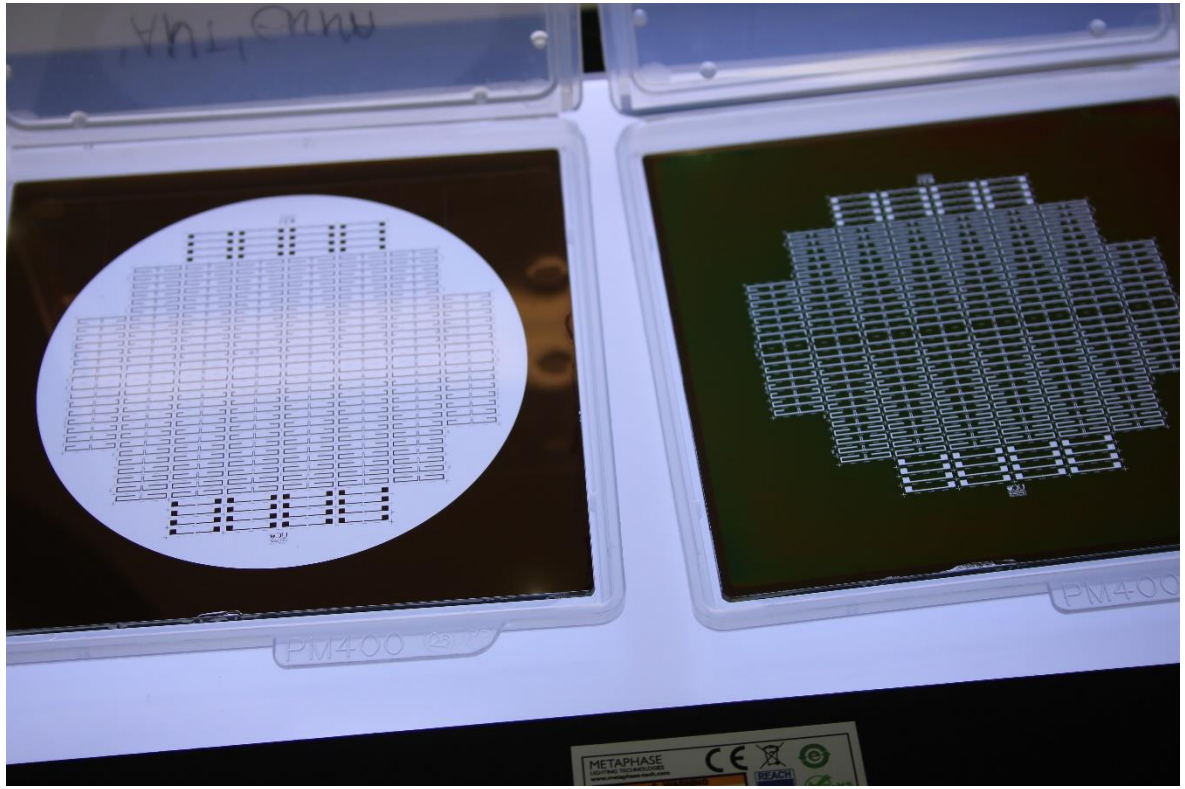
Meandered Dipole and Stub

Radiation pattern is omni-directional in horizontal plane.
Stub has negligible impact on radiation pattern and this is to be expected as the two line currents cancel in the far-field.

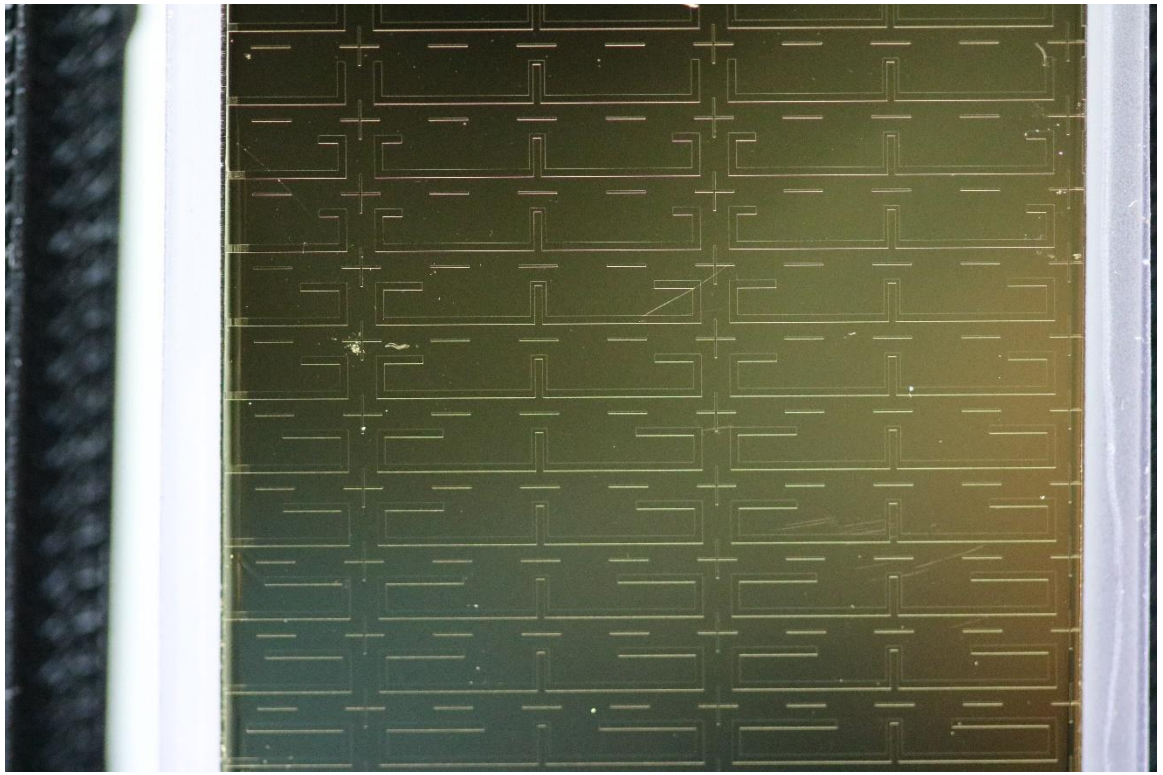


Tag Fab – [UC nano-fab lab]

Mask

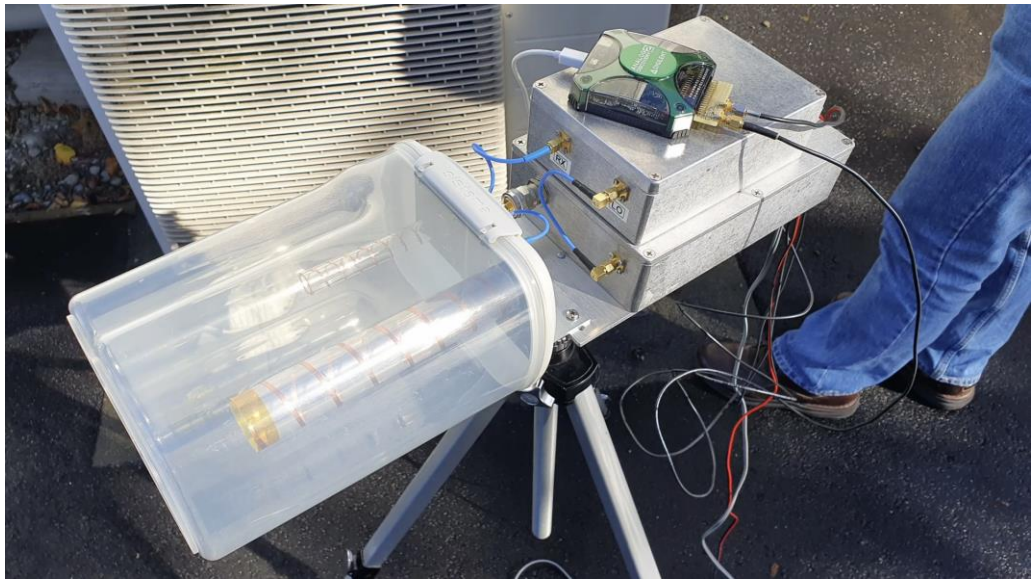


Test slide:

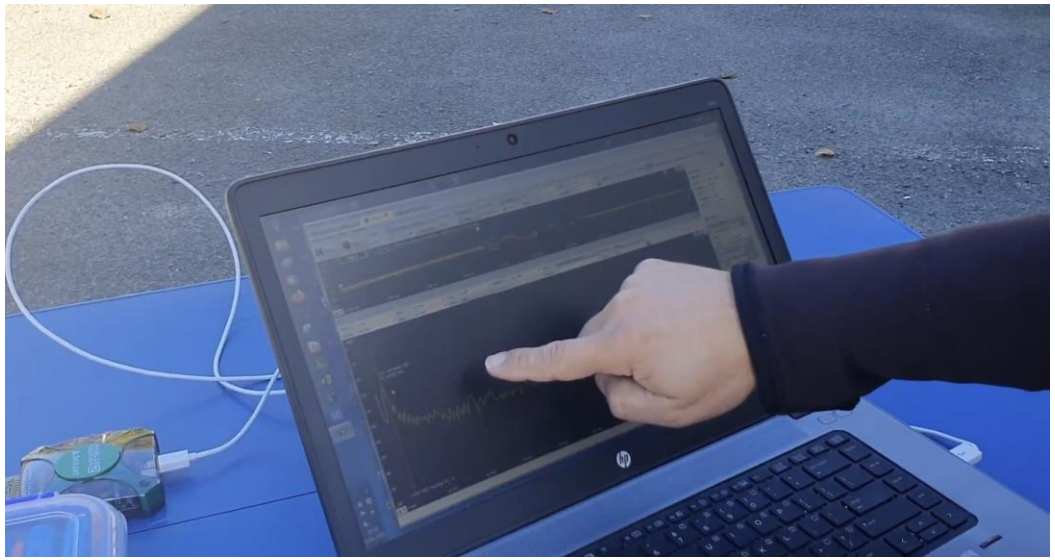


- Next challenges:
  - Resolution, fragile, placing small diodes

RADAR Design. Subcontract [Greg Storz (Consultant, AKL)] Prototype testing



Car-park test, April 2022



New RADAR Design. 9GHz/18GHz [G. Storz]

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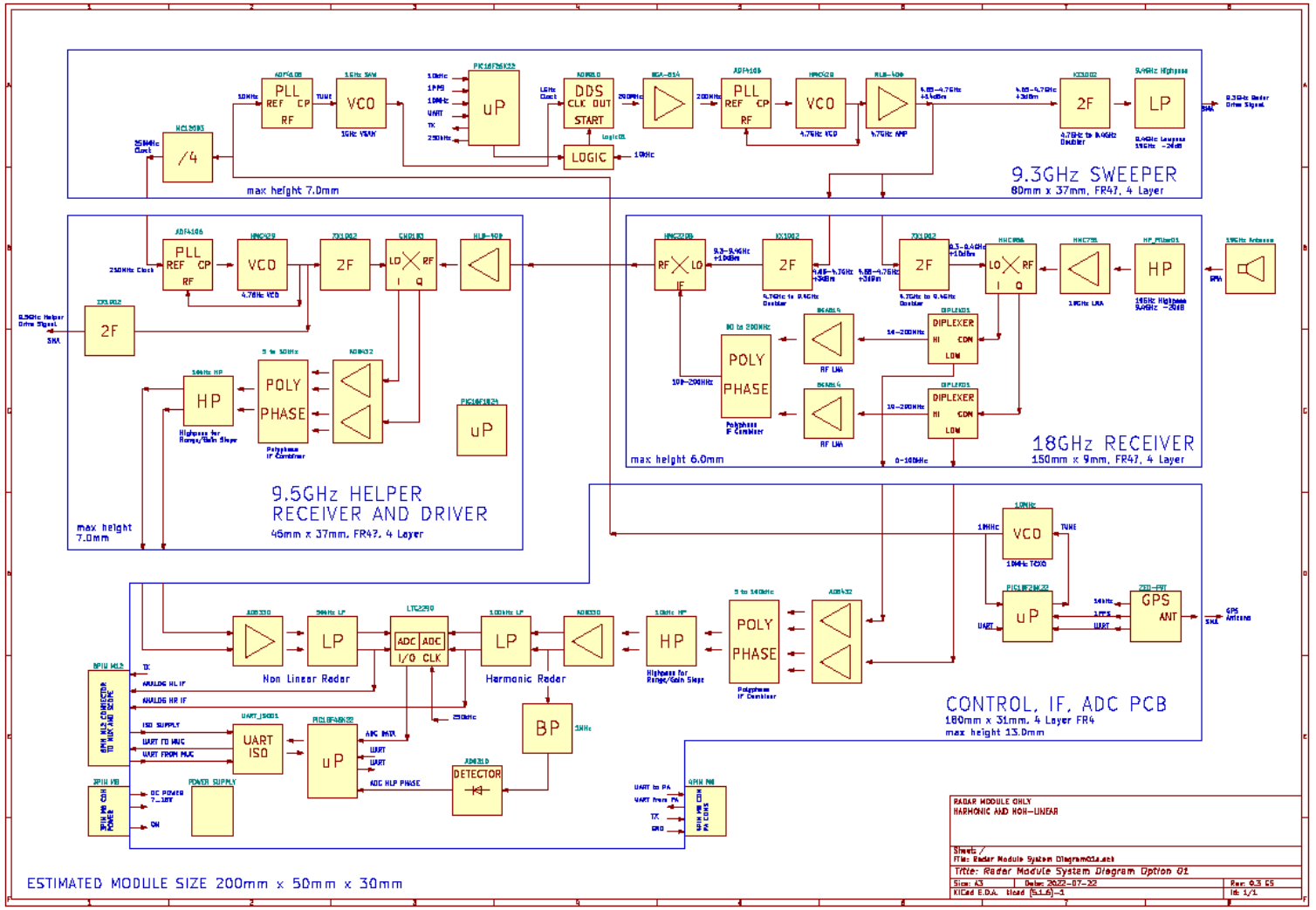
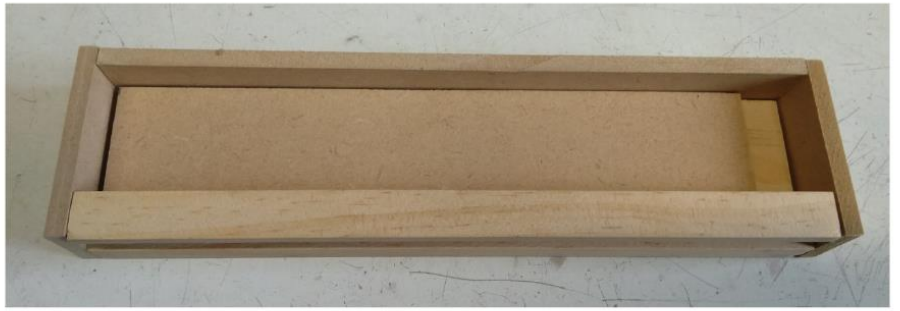
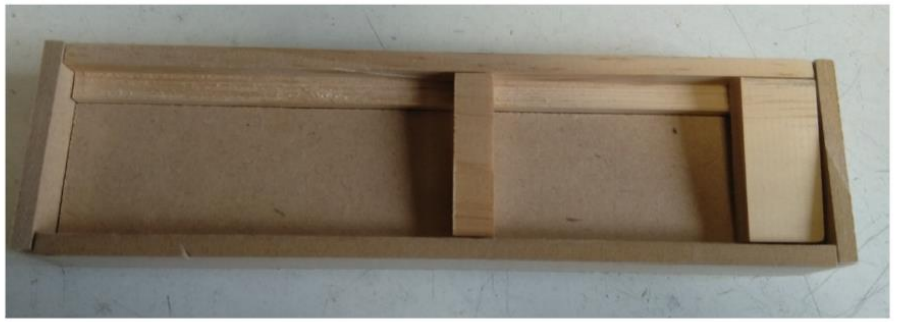
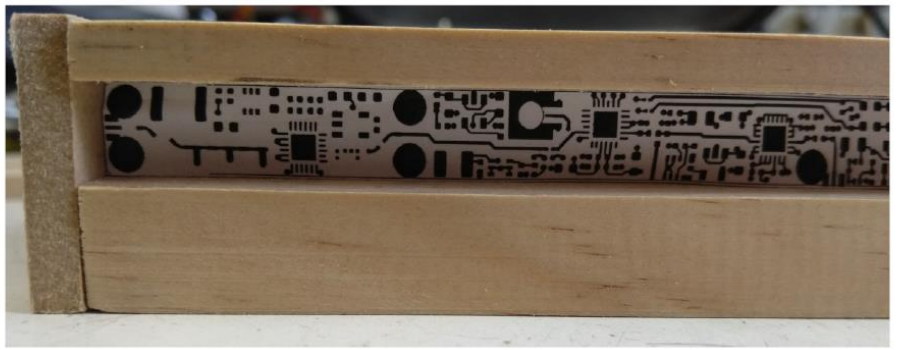


X-Band Harmonic Radar mockup







Space for 18GHz Receiver

RaceRanger: Draft busting in triathlon

- Start-up: RaceRanger.
- Athletes have limited time to overtake others, or face time penalties.
- This technology gives visual display of time within overtaking box
- Combination of wireless technologies
  - BT beacons to detect bikes in proximity to each other
  - UWB ranging to accurately measure range
- Technology field tested. Limited production run. First race Sept., Spain.

New mmWave channel models with spatial consistency
Will Sloane (PhD student). Internship at NIST (USA)

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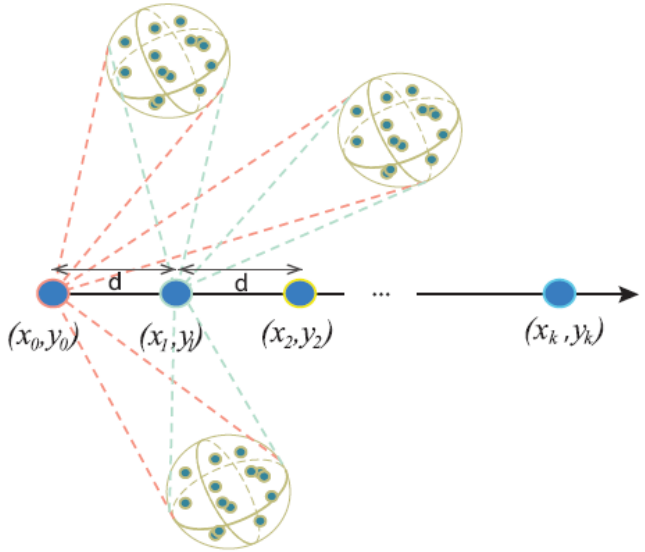
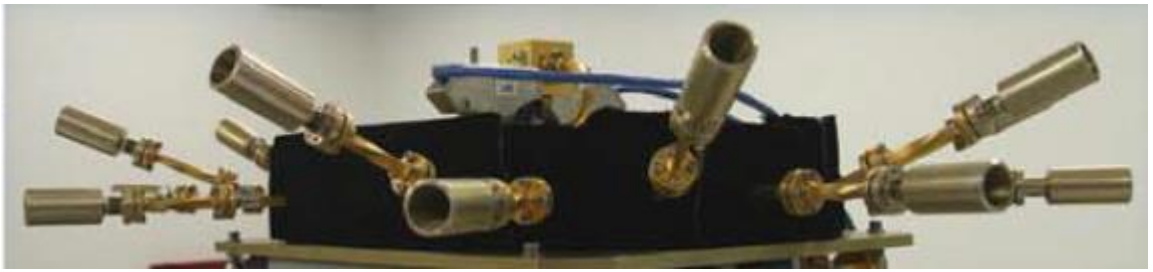
- Need a model where parameters continuously evolve, for beamsteering and tracking.
- As users move, channel parameters are correlated to previous positions.
- Represent the channel with clusters of reflectors. Model path evolution as the receiver moves by the clusters.



- Utilise 60GHz 3D channel measurements, National Institation of Standards & Technology (NIST)



Model development using mmWave Channel Measurements at 60GHz (NIST)

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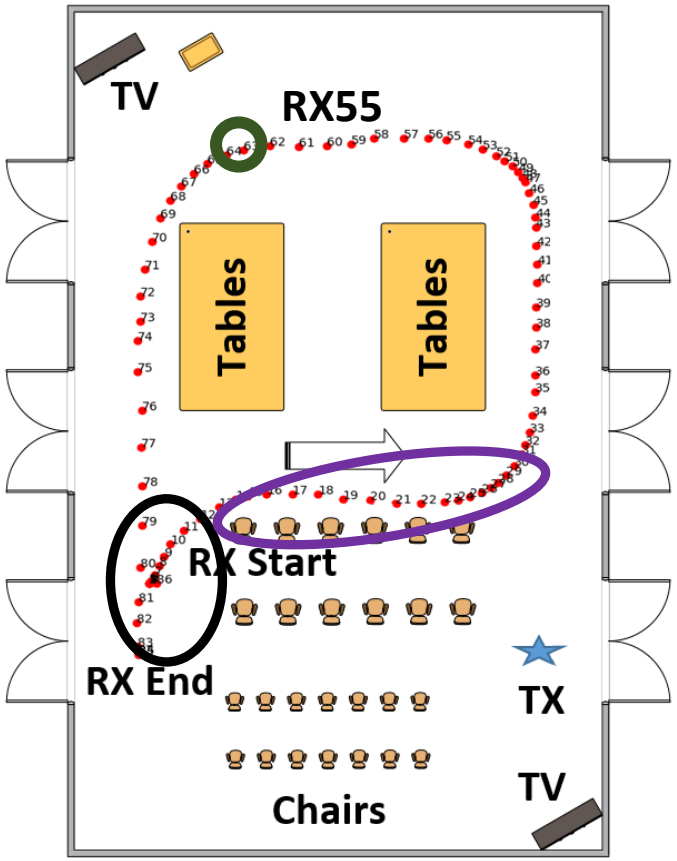
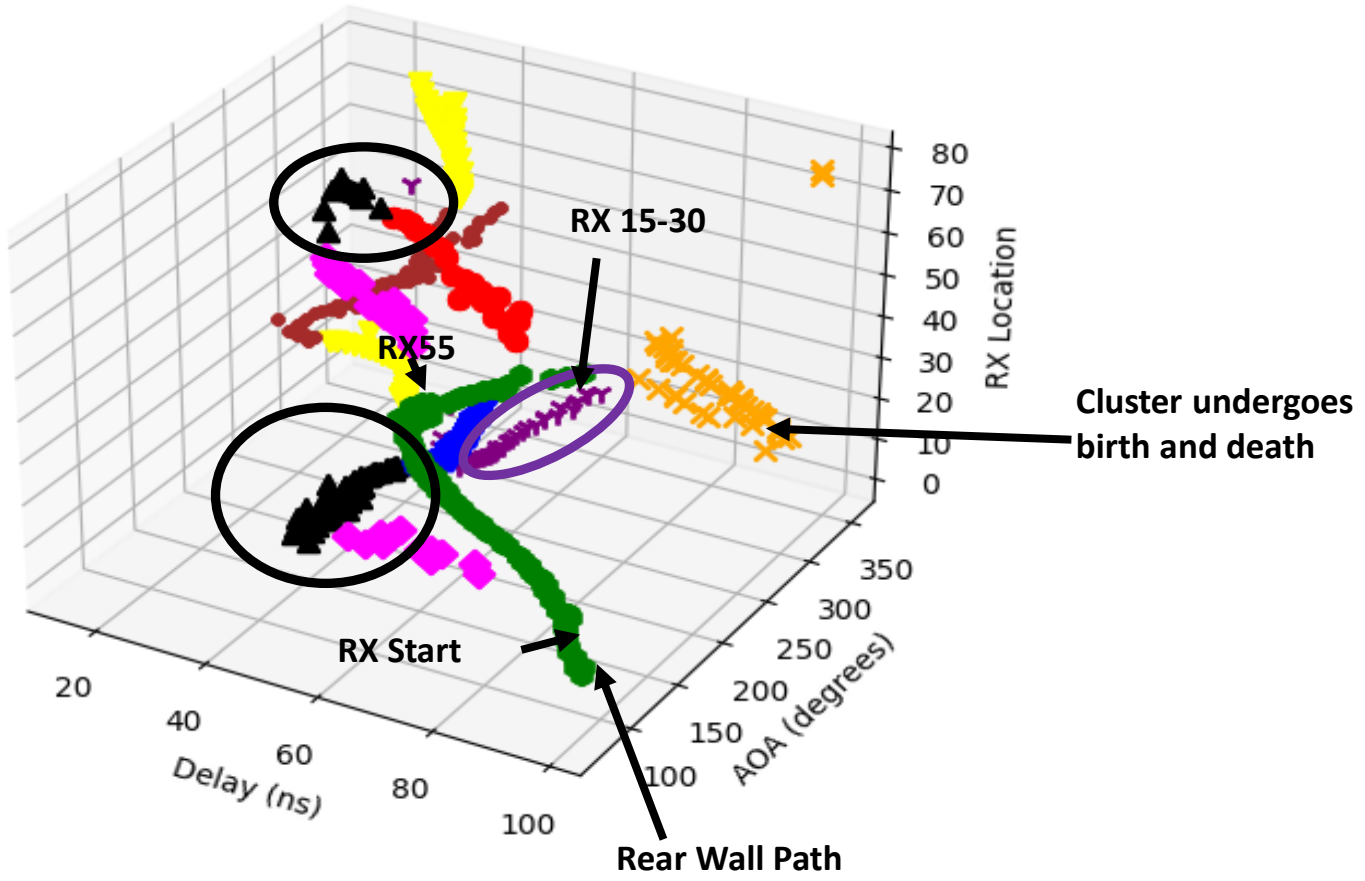
Lecture Room (10x19m)



RX track
33m



Joint **delay-angle-location** clustering

Other postgraduate student research

- **Aston Taylor** (Masters): mmWave radar: sensing & tracking
- **Zubia Ishrat** (PhD): High sectorisation & frequency re-use for narrowband utility field area networks.
- **Amy Inwood** (PhD): Massive MU-MIMO/RIS