

# Towards Inverse Synthetic Aperture Radar (ISAR) for Small Sea Vessels

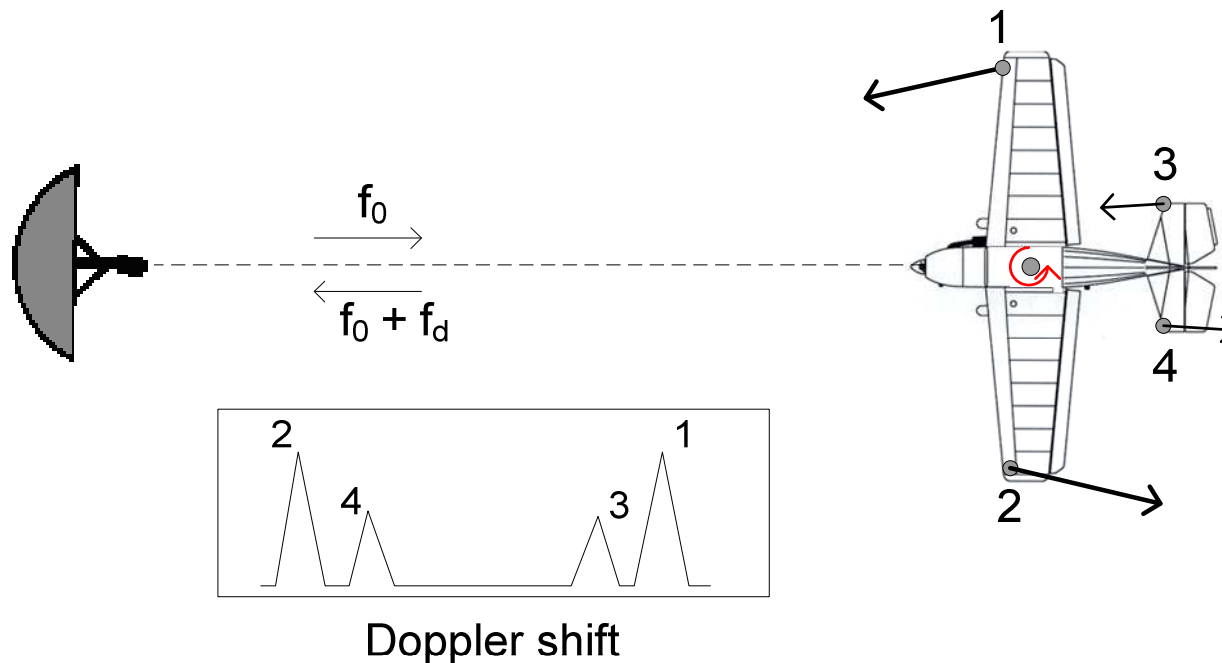
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# What is ISAR?

- Technique that produces cross range dependent doppler frequencies



# Applications of ISAR

- Produces a radar image of the target
- Non-cooperative target recognition (NCTR)

Photo of the impala

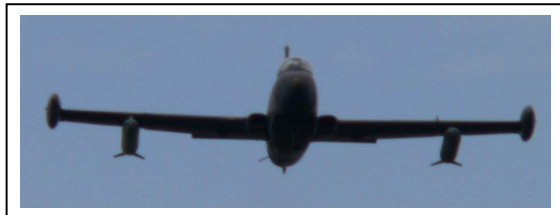
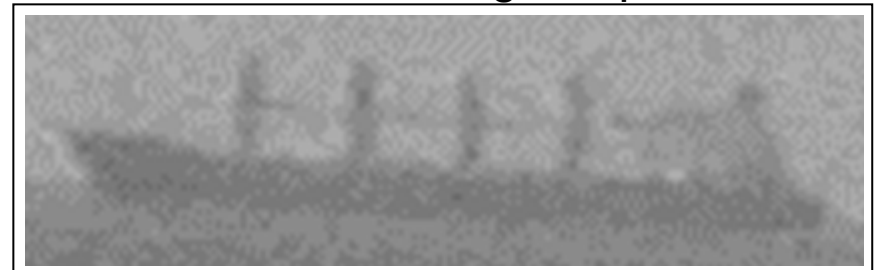
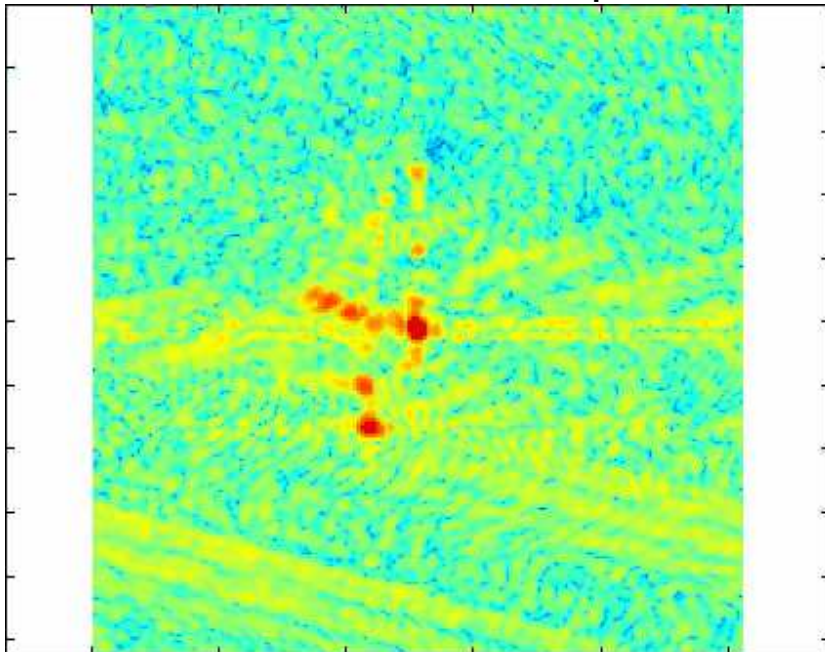


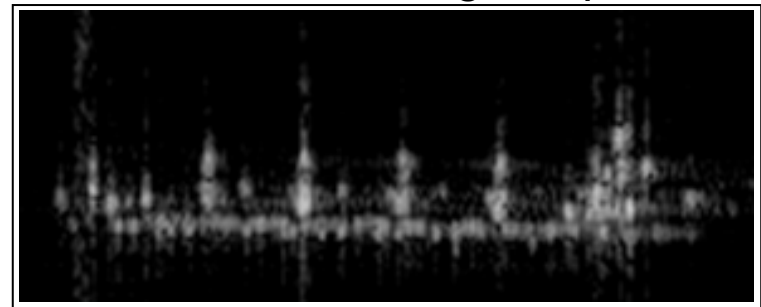
Photo of large ship



ISAR movie of an Impala

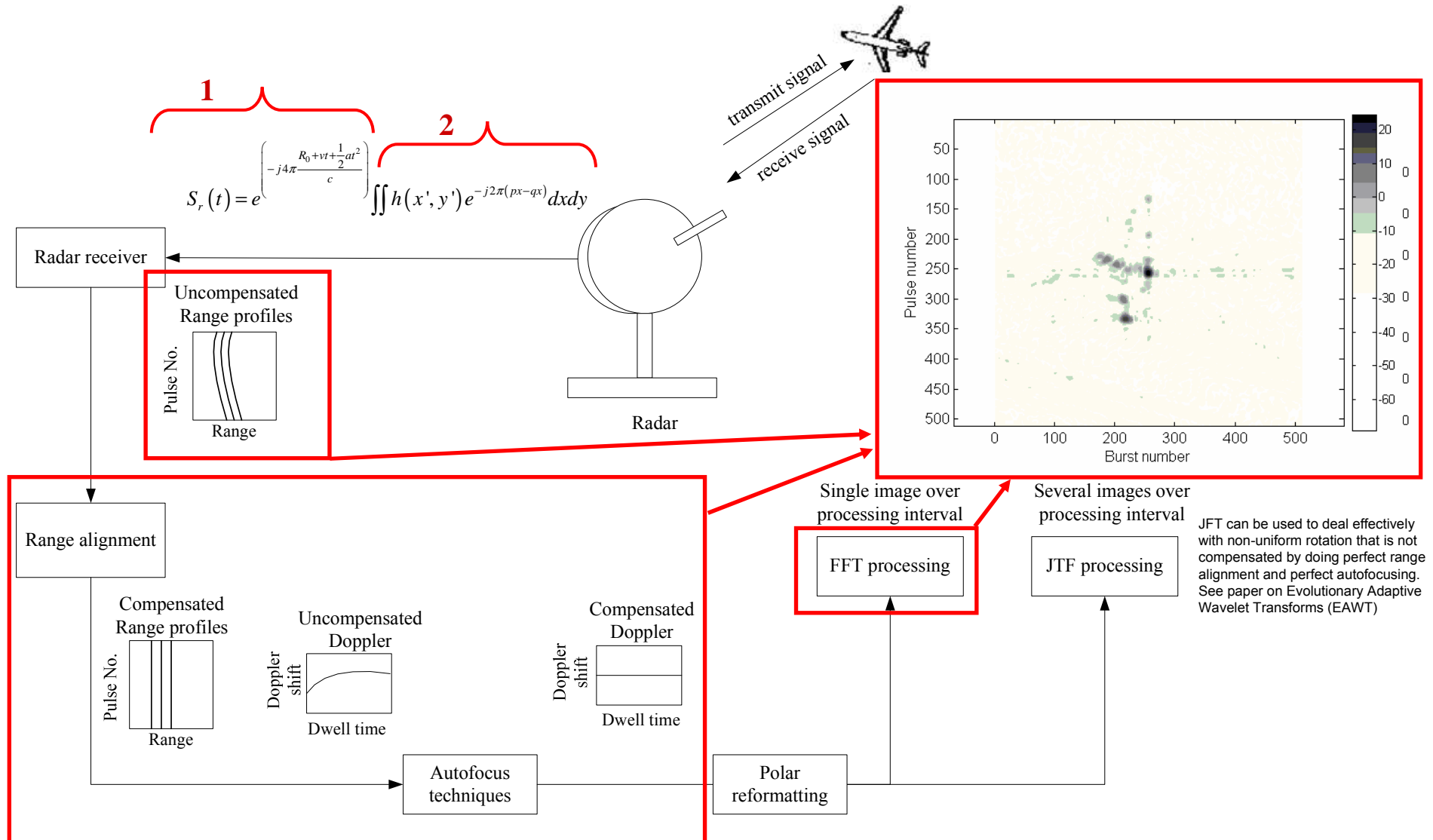


ISAR of large ship



Credit: Telephonics APS-143B (V)3

# Block diagram for ISAR processing



# Identification of new ideas

- Old classification algorithms do not exploit the persistent surveillance capability of the newly proposed Awarenet radar
  - No context, no ability to improve over time
- Development of new classification algorithms that improve their performance over time
  - Takes into account that target can be observed for a long period of time
  - Same mistake would not occur twice.
- Joint motion compensation and classification algorithms
  - All previous work in the literature looked at these algorithms separately. Can information from the motion compensation stage be used to improve the classification of targets?

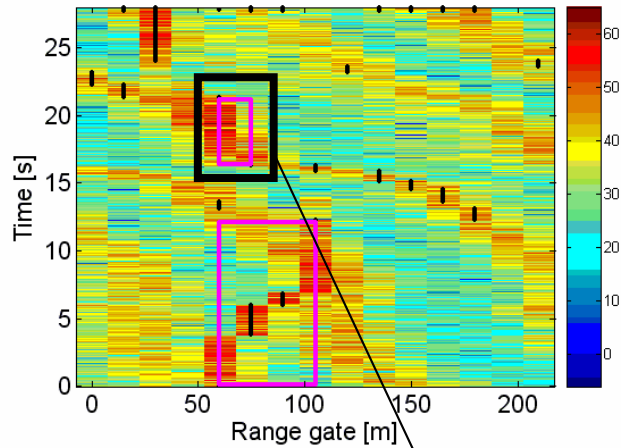


# Real ISAR Experiments in Arniston 2006

- Fynmeet tracking radar
- Small fishing vessels at sea
- Data captured
  - Radar data
  - GPS data
  - INS/3D motion data – Mti sensor
- Processing tools were developed
- Motion compensation was applied (AUTOCLEAN)



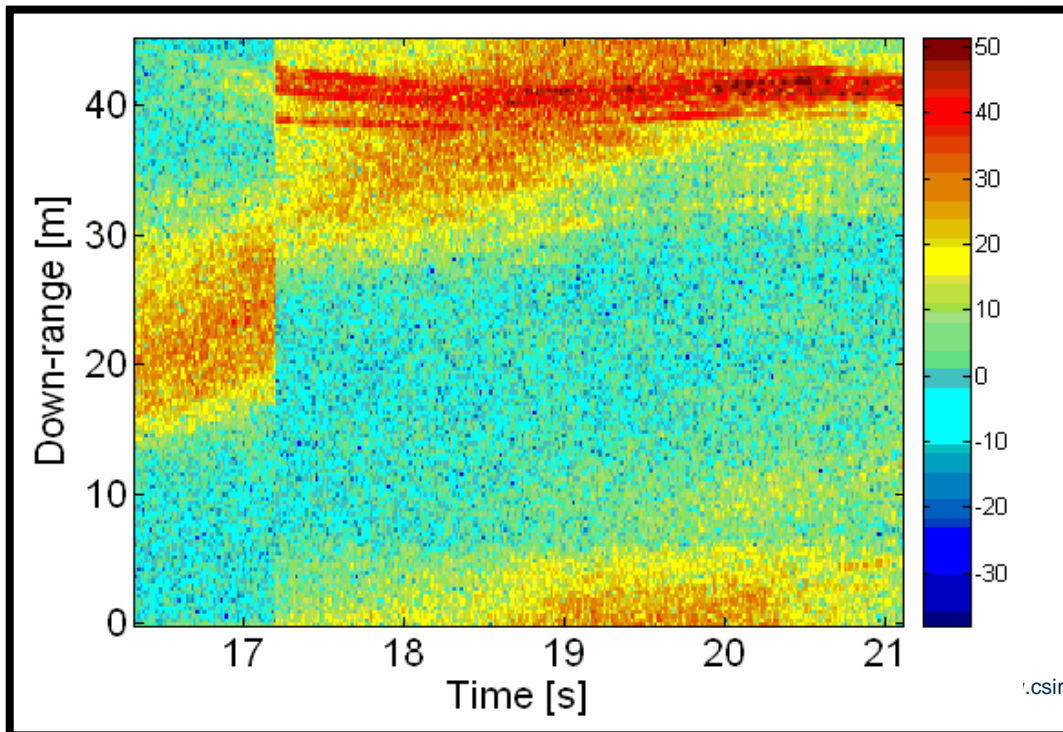
# Issues with AUTOCLEAN



- AUTOCLEAN (motion compensation – ISAR)
  - Assumes RCS of scatterers constant throughout processing interval
  - Assumes position of scatterers are fixed throughout processing interval

If not satisfied

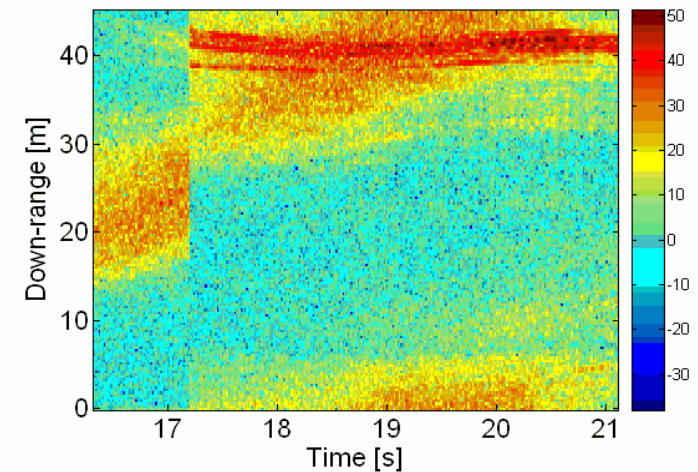
Leads to a blurred ISAR image



# Effects I don't yet understand

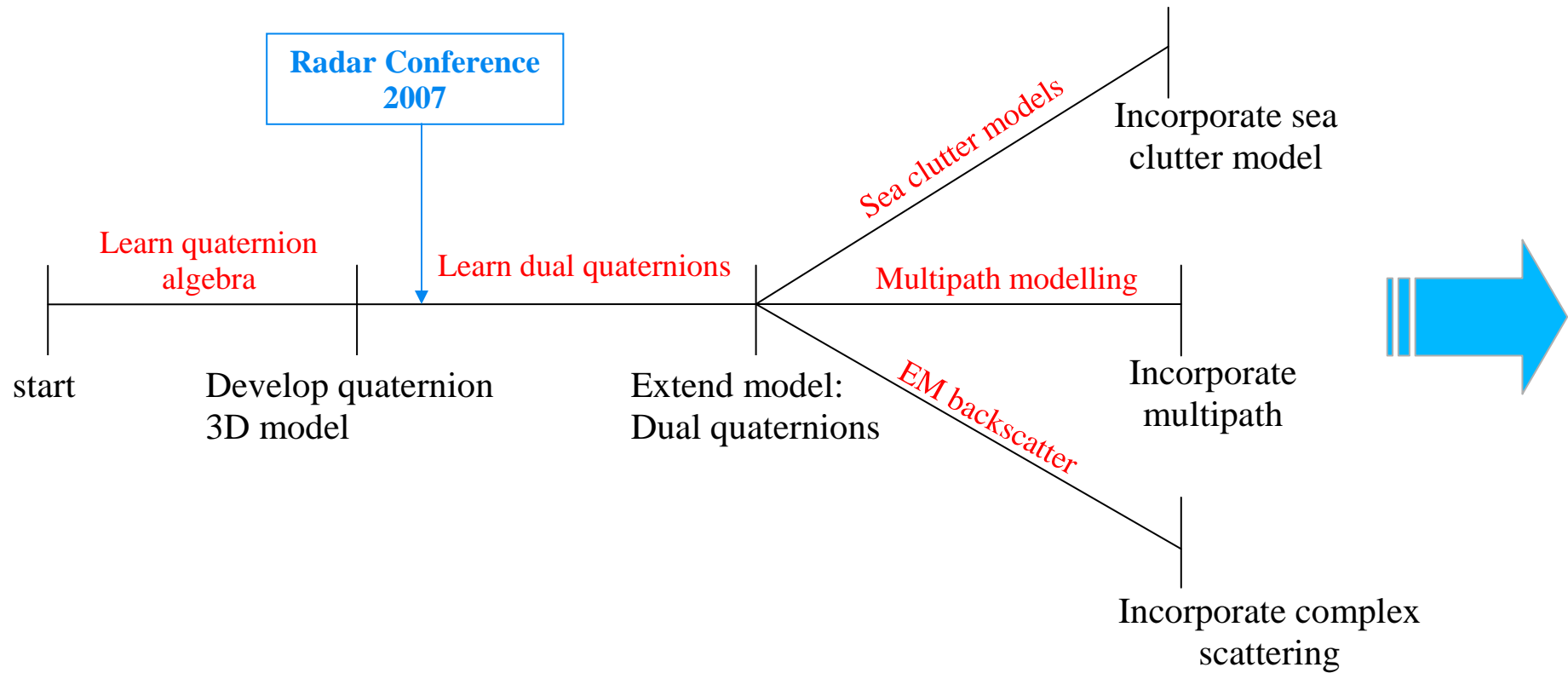
- Effect of complex 3D motion on ISAR blurring
  - Literature deals with target being confined to 2D space
- Effect of multipath on ISAR blurring/ghosting effects
- Complex scattering
  - Diffraction from the edges of the sea vessel
  - Walking scatterers
- Sea clutter

Cannot isolate why the ISAR image is blurring from processing real data





# Building the mathematical system model



# Summary and conclusions

- Introduction to the concept of ISAR and applications
- Signal Processing steps needed for ISAR
- Identification of new work
- Recording and analysing radar data
- “Issues I don’t yet understand”: sensitivity analysis is required
- Way forward: building the mathematical system model



# Questions?

