Is it a bird, or something else?

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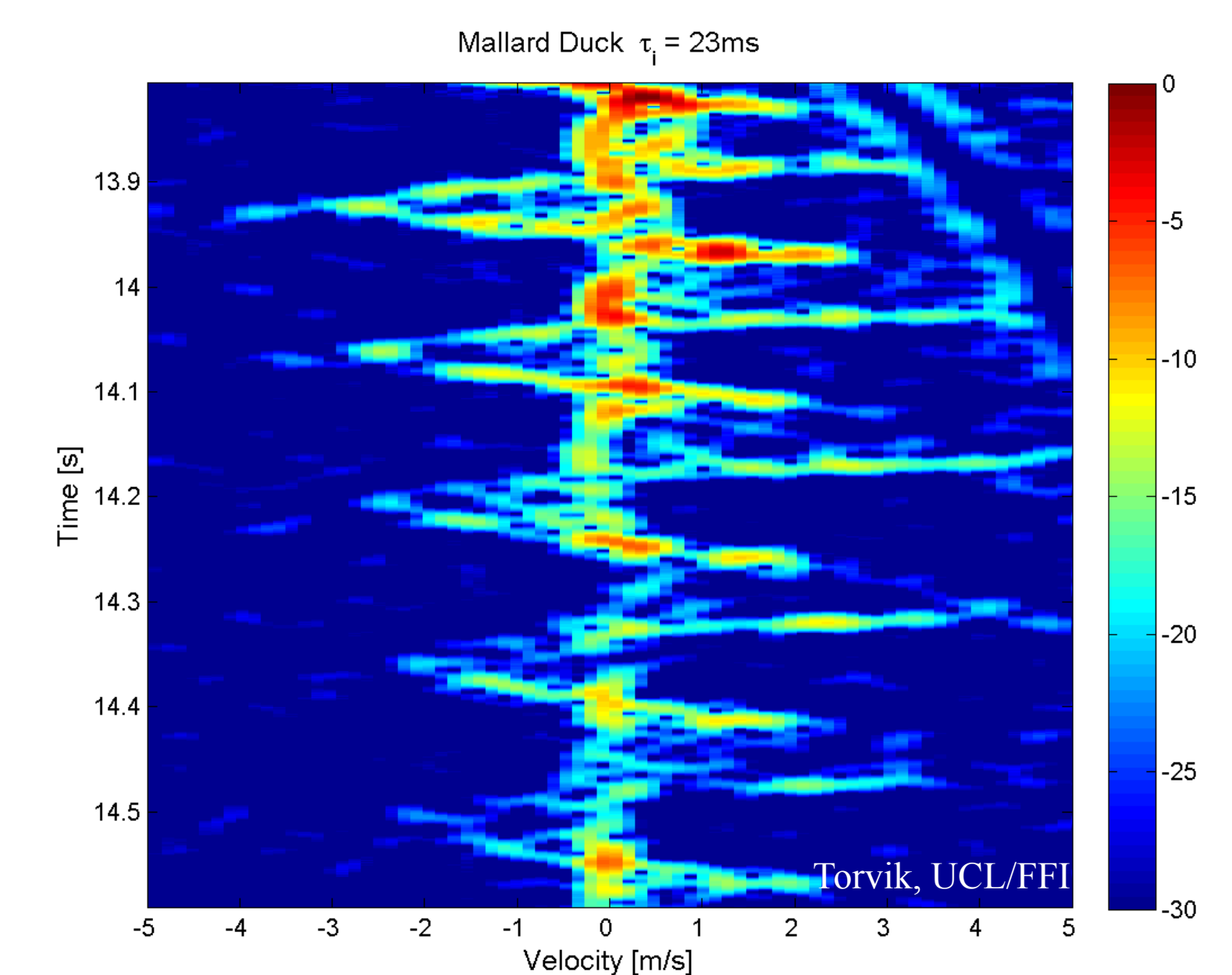
UCL

Background

Modern radar receivers are becoming more sensitive than their predecessor, which is believed to be a necessity for detection of low signature targets. As a result, it is assumed that birds, with RCS of the same or even larger magnitude, will represent a potential problem for radars in the future. This applies both in resource management, where a large number of targets can overwhelm the system, as well as for discrimination between UAVs and birds.

Photo: FFI

Traditional methods

Non-cooperative Target Recognition (NCTR) of air targets are traditionally implemented in tracking radars operating at higher frequencies (9 GHz and above).

B737-600 (LN-RPE)
Torvik, UCL/FFI
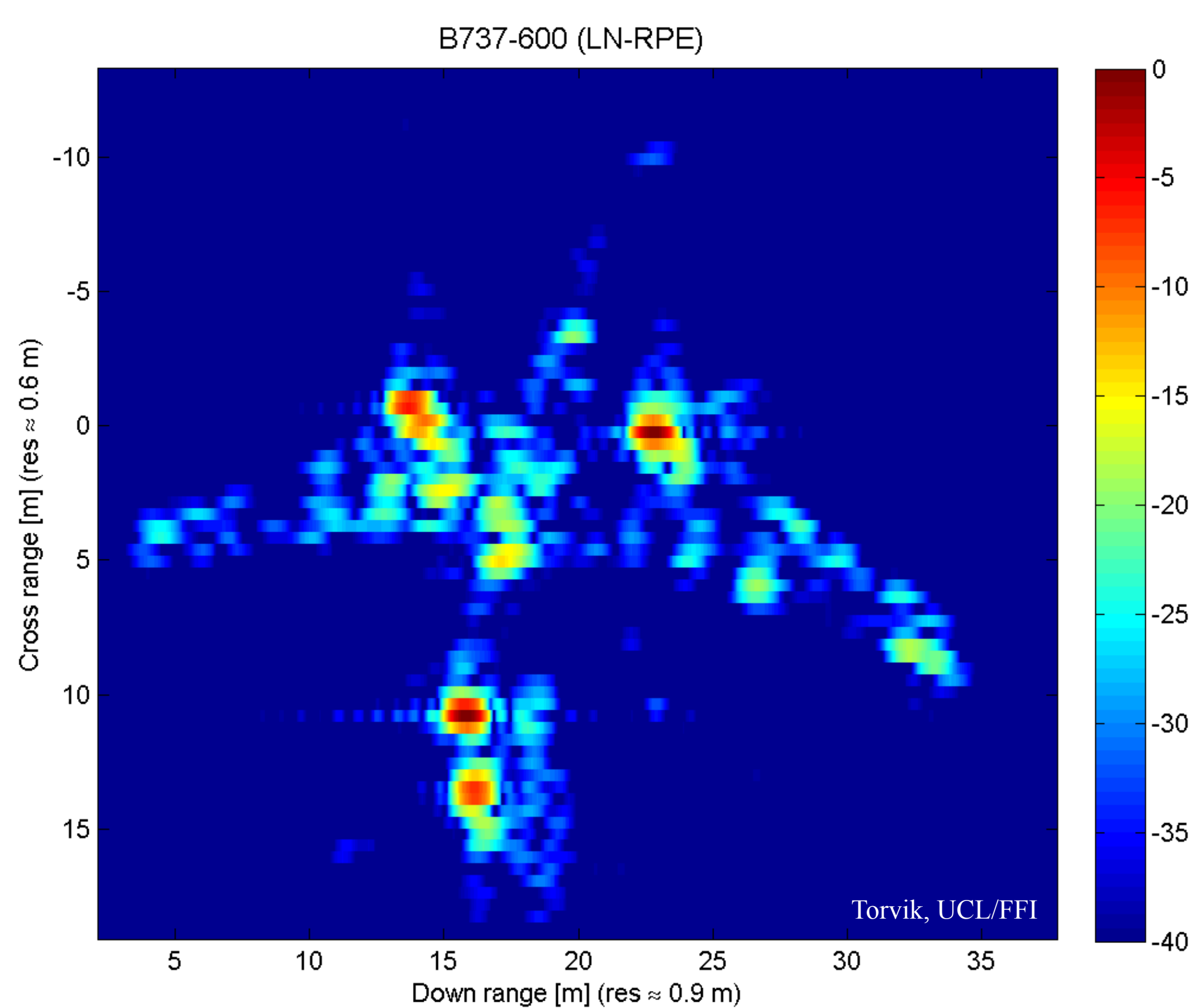
The following techniques are being evaluated for use in a lower frequency surveillance radar system:

- High Range Resolution (HRR)
- Inverse Synthetic Aperture Radar (ISAR)
- Jet Engine Modulation (JEM)
- Micro-Doppler
- ΔK / Matched illumination

The main challenge of introducing recognition capability to a long range surveillance radar system is the poor resolution associated with update rate, velocity, range and cross-range compared to dedicated systems. Modern AESA technology may improve this, by offering longer time on target and wider bandwidths.
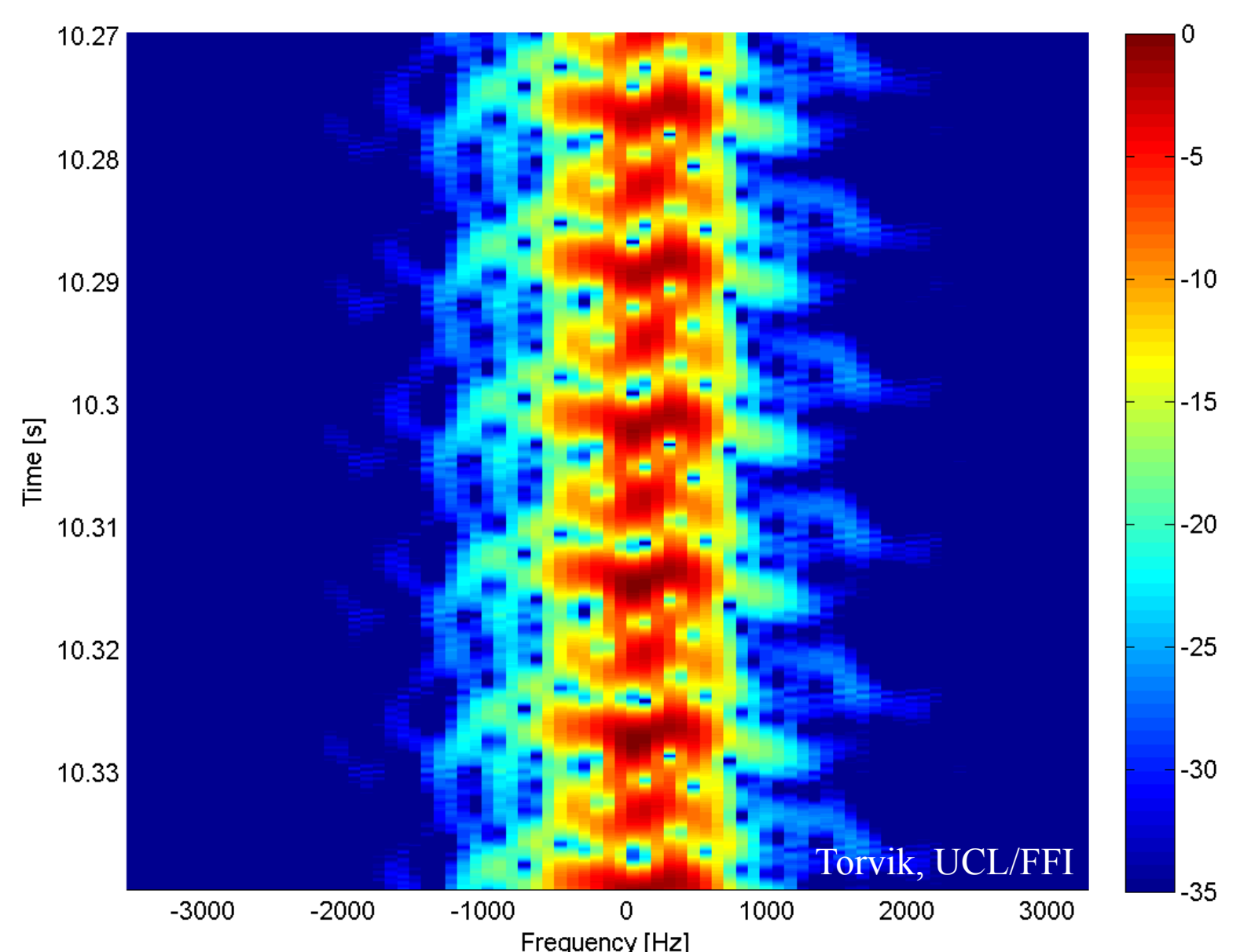
Radar signatures of birds and UAVs

In the literature we find RCS of birds ranging from -40 dBsm to -10 dBsm, which implies that large birds will be detectable at long ranges in modern systems. However, in the context of classification RCS of the parts contributing to the signature is crucial.

Some initial data collections were done of a Mallard duck with a low power K-band (24 GHz) CW radar. This shows a few prominent scatters and a considerable contribution of backscattered energy from the wings (~ 50%).


Photo: Shutterstock.com

Mallard Duck τ_i = 23ms
Torvik, UCL/FFI

A data collection was also done of the Puma UAV operated by FFI in Norway. Modulations from the small plastic propeller was found in the dataset.

Photo: FFI

Torvik, UCL/FFI

Future work

Hardware is being developed to investigate signatures of birds and UAVs. The goal is to collect fully polarimetric data in L- and S-band.
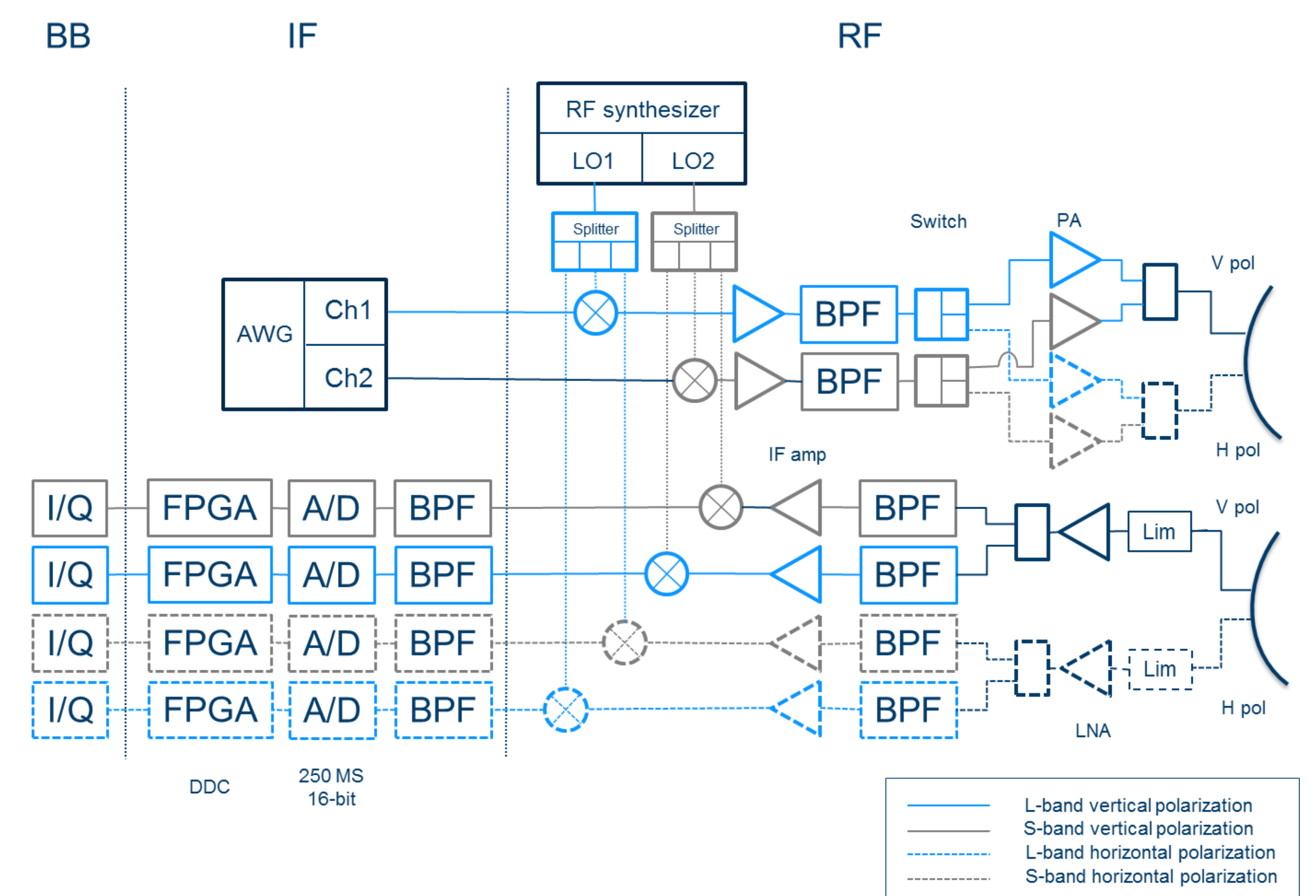
Further work will include simulations and measurements of birds and UAVs. A large measurement campaign of UAVs and drones is scheduled for November 2013. Suitability of traditional and new techniques will be evaluated for use in modern surveillance radar systems.