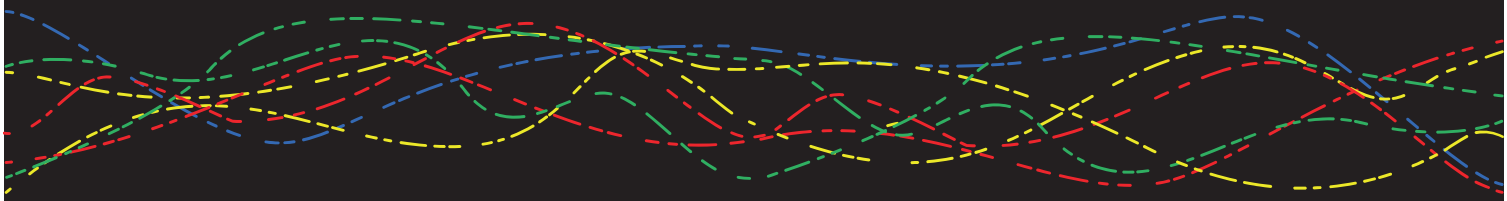
Wind turbine shutdown using radar

Progress and challenges



Electromagnetic Waves and Wind Turbines
TU Delft – 6/7 December 2018
R. van der Meer

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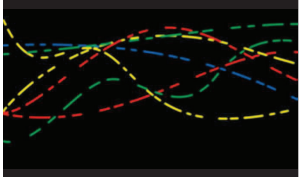

Overview

- Introduction bird-collision mitigation
- Our history
- MAX radar
- System overview
- Eemshaven
- Future research

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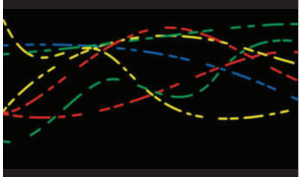

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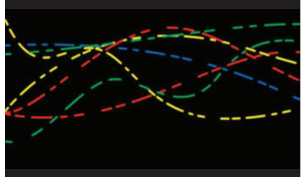
Introduction

Video Inrtoduction...

The problem

- Growing demand for renewable energy
- Turbines & birds share the same interest of areas with strong wind currents
- Number of casualties hard to measure and show large dependency on area
- Threat to migrating birds as well as local birds
- Need for pre-construction research



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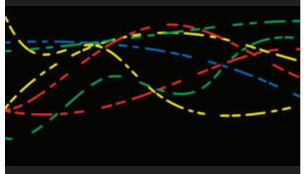
Mitigation

Pre-construction	• Assess migration patterns • Assess bird populations & species • Human observer, camera & radar
Post-construction	• Measure change in migration patterns • Measure number of crossings of rotor swept area • Measure intensity and patterns of 'local traffic'
Operational	• Wind turbine shutdown during migration or specific activity



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Why (not) radar

Pro's:	Con's:
• Day and night • 'All' weather • Large coverage • Automatic storage of data • Low operational cost	• Significant initial costs • Requires infrastructure • No species recognition

"ROBIN'S CURRENT STATE OF THE ART BIRD RADAR WITH 24/7 HIGH RESOLUTION BIRD DETECTION, IS A MUST FOR ACCESSING AND MITIGATING THE RISK IN ANY LARGE SCALE WINDFARM DEVELOPMENT…"

Mati Kose, Ornithologist, conservation and EIA expert University of Tartu, Estonia

History of ROBIN Radar Systems

- 1980: TNO Project: *Radar Observation of Bird INtensity*
- 2010: TNO spun-out, technology: marine radar (2D systems)
- 2012: Combination of horizontal and vertical radar
- 2017: Full 3D system: MAX

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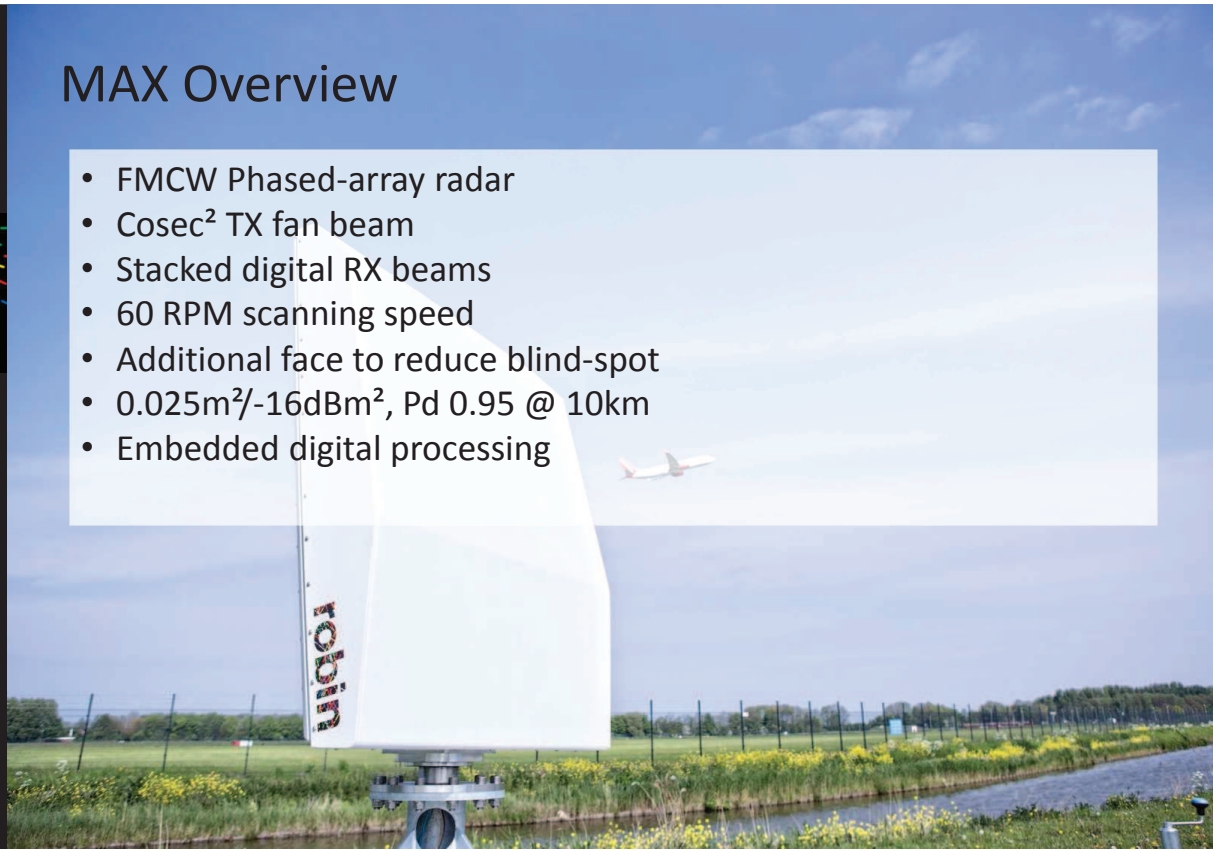
MAX Overview

- FMCW Phased-array radar
- Cosec² TX fan beam
- Stacked digital RX beams
- 60 RPM scanning speed
- Additional face to reduce blind-spot
- 0.025m²/-16dBm², Pd 0.95 @ 10km
- Embedded digital processing



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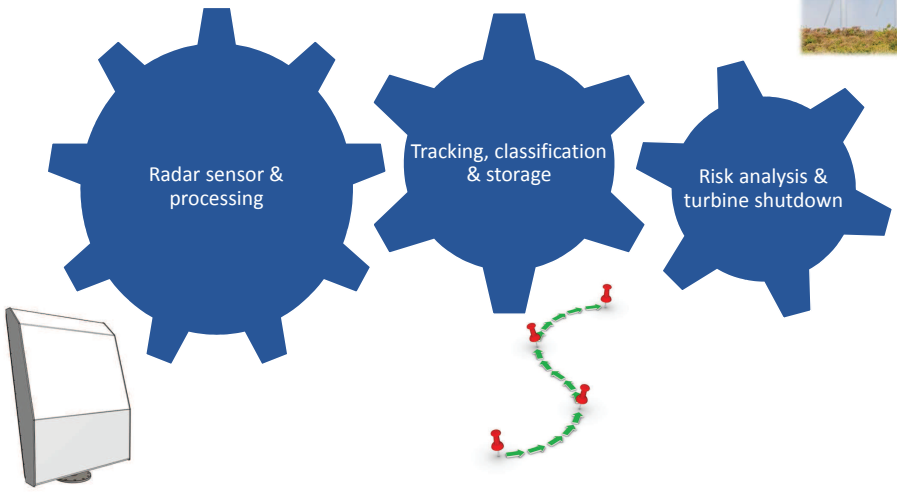
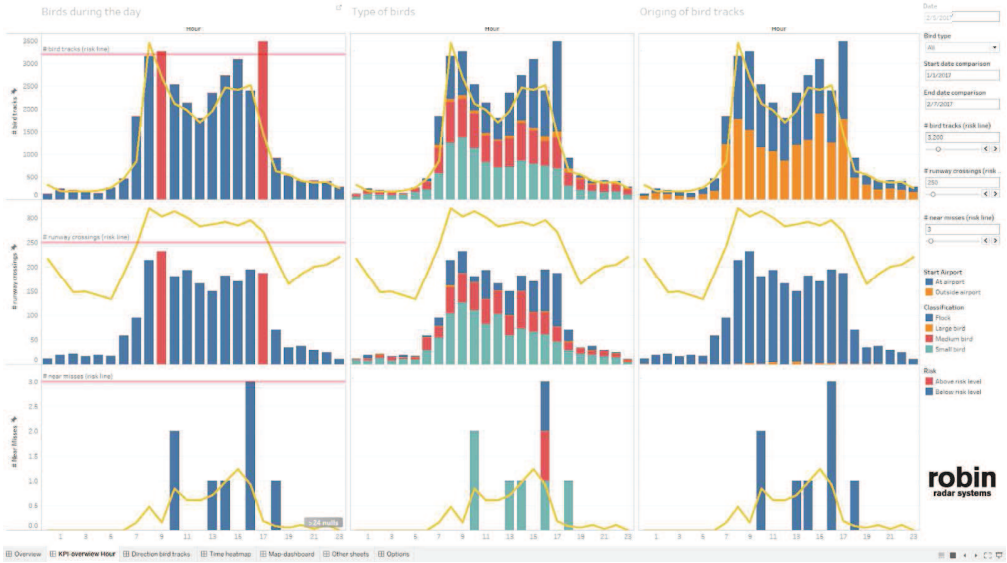
Processing overview



Automatic wind turbine shutdown

- Mean traffic rate (MTR) through rotor-swept area
- Mass migration during adverse weather conditions
- Soaring behavior in vicinity of turbines



Eemshaven

Case-study

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Case-study: Eemshaven

Bureau Waardenburg
Ecologie & Landschap
www.buwa.nl

- Bureau Waardenburg, commissioned by:
  - The Province of Groningen,
  - Ministry of Infrastructure and Water Management and,
  - Ministry of Economic Affairs and Climate Policy
- Uses MAX radar bought from ROBIN end 2017
- One of our 'launching customers'

Project goal:

Deliver information on the success and optimization of shutdown-on-demand programmes to reduce numbers of bird mortalities and limit the reduction in energy production.

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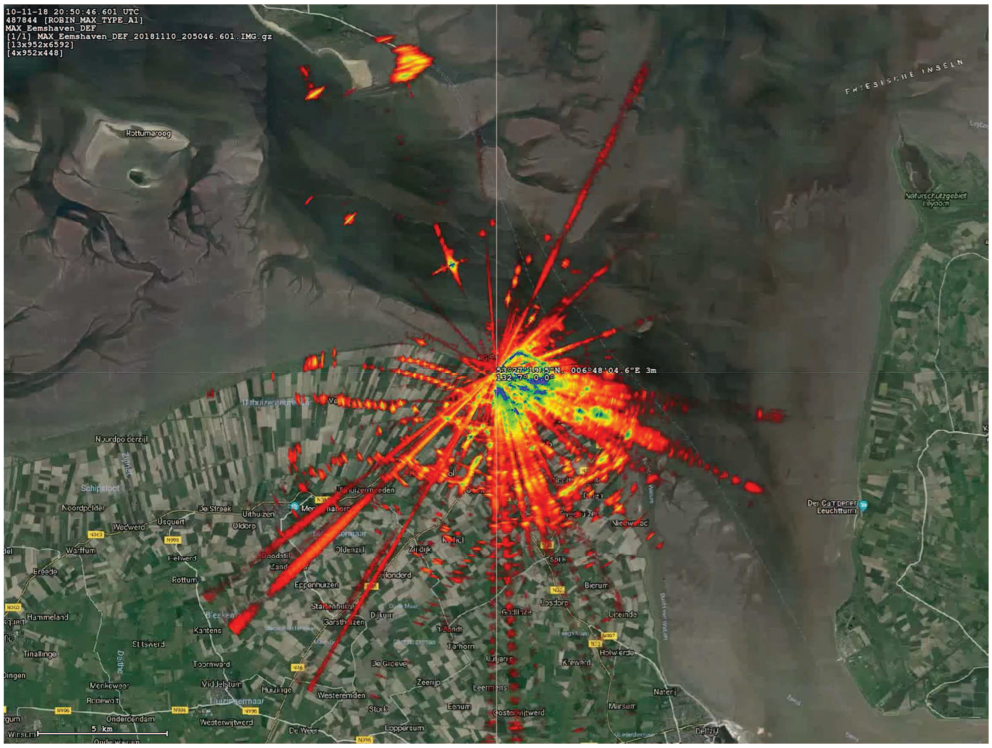
Eemshaven raw radar video (1/4)



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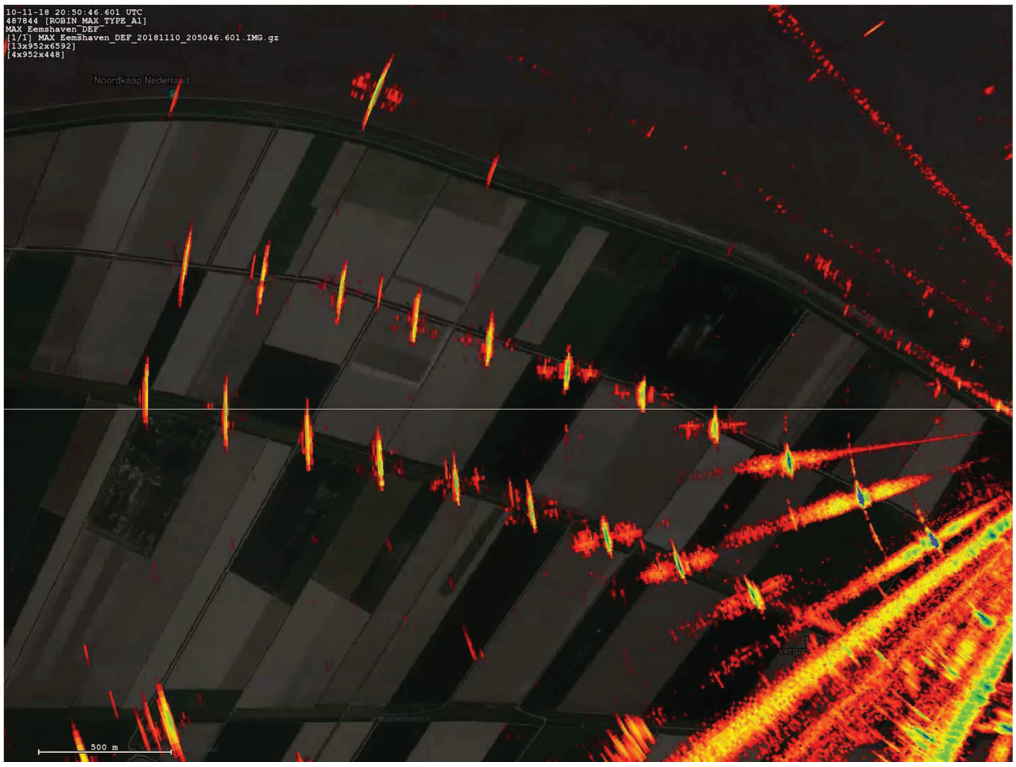
Eemshaven raw radar video (2/4)



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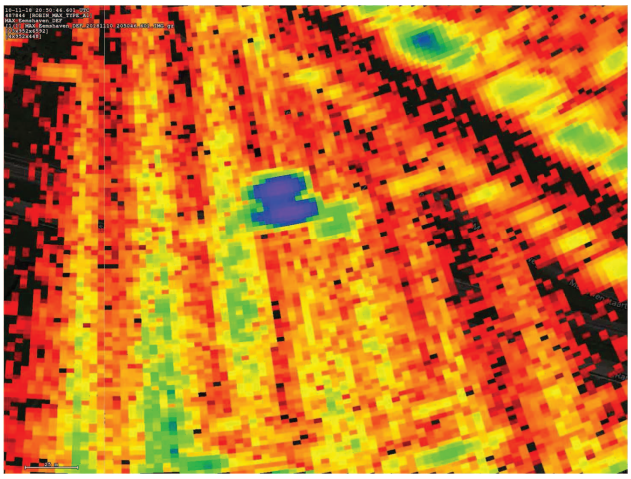
Eemshaven raw radar video (3/4)



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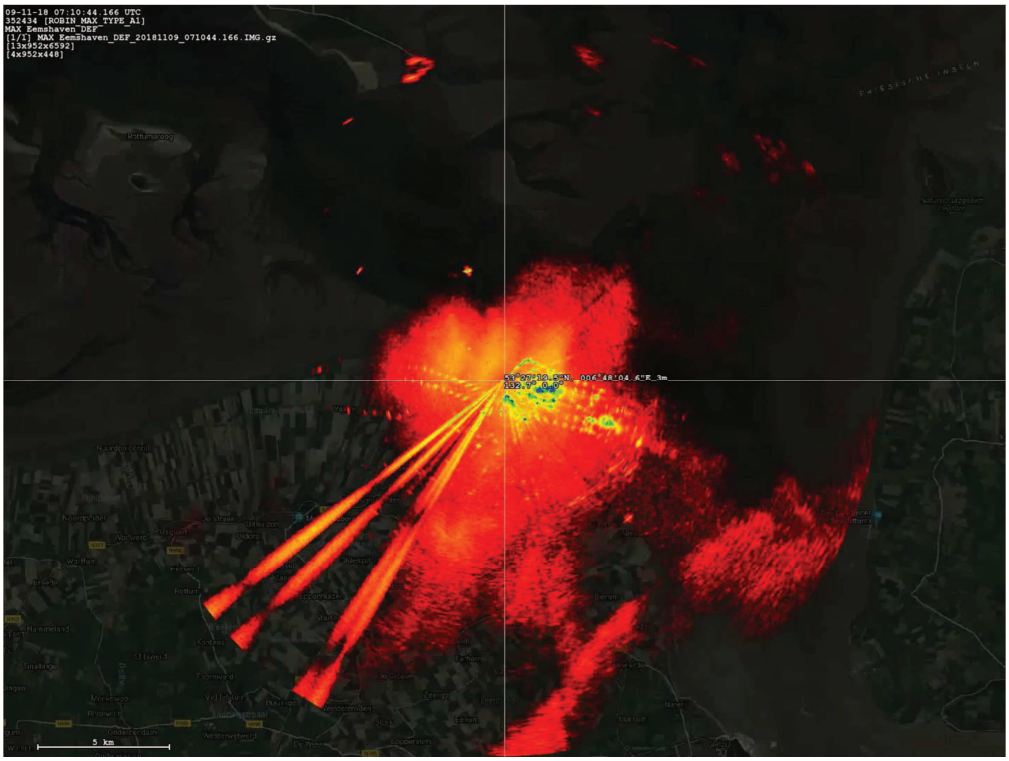
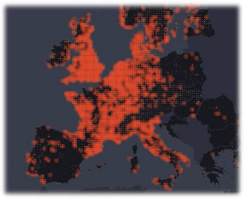
Eemshaven raw radar video (4/4)



Future research

Automatic visual classification
- Shutdown on ‘local behavior’



Short-term forecasting
- More predictable shutdown

Thank you

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