

# Tracking radar "Superfledermaus"

1969 model

x-band (3.3cm wave)

150 kW peak power

0.3  $\mu$ s pulse length

2082 pulse rep. freq.

2.2° nom. beam width

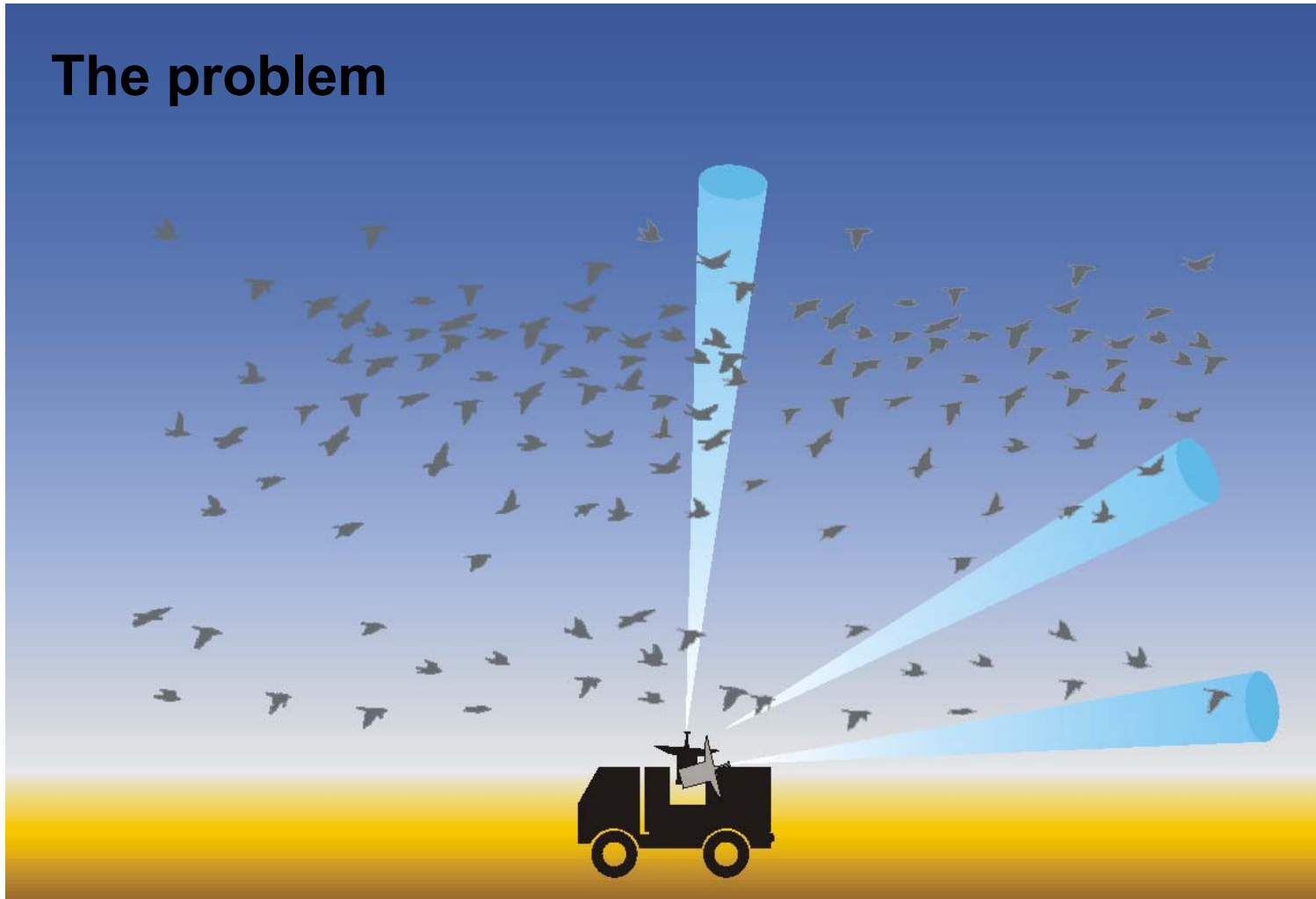




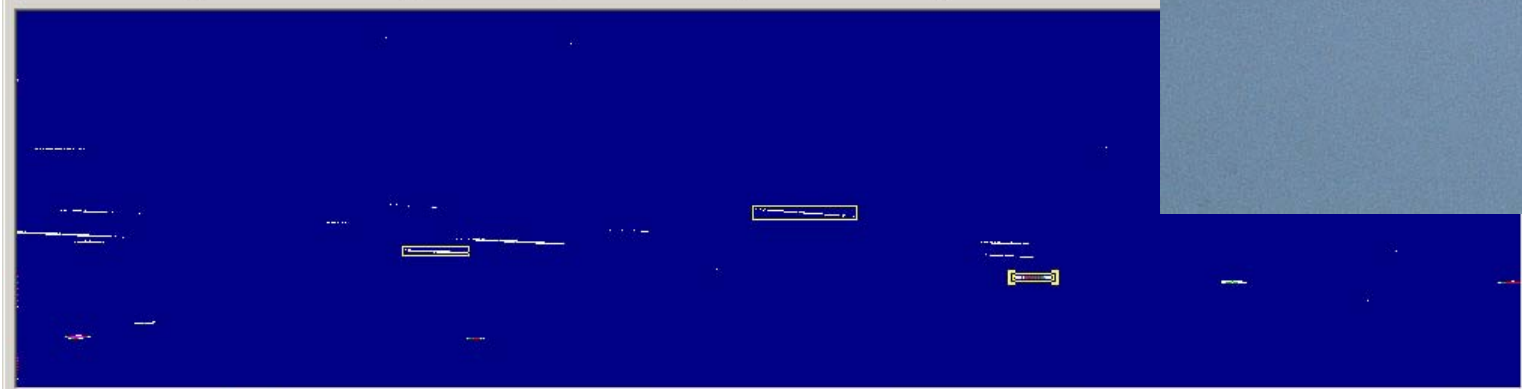
# Automatic identification

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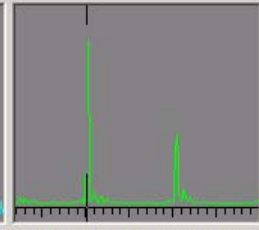
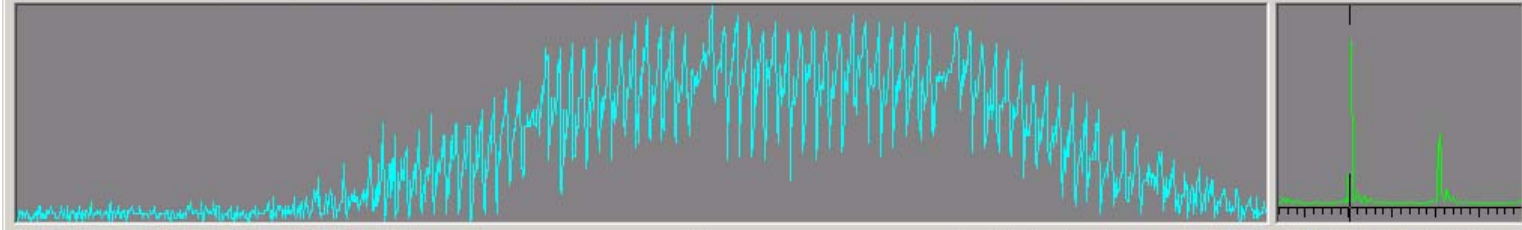
The problem



<b>General:</b> Radar-Site: <input type="text" value="C"/> Date: <input type="text" value="29.08.2003"/> Time: <input type="text" value="22:13:00"/> Threshold: <input type="text" value="14"/> Offset: <input type="text" value="6"/> VSU: <input type="text" value="5"/>	<b>Antenna position:</b> Elevation (CMD): <input type="text" value="504"/> Elevation Start: <input type="text" value="504"/> Elevation Stop: <input type="text" value="504"/> Elevation Offset: <input type="text" value="0"/> Azimuth (CMD): <input type="text" value="4803"/> Azimuth Start: <input type="text" value="4803"/> Azimuth Stop: <input type="text" value="4803"/>	<b>Threshold-Control:</b> <input type="radio"/> Synthetic <input type="text" value="14"/> <input checked="" type="radio"/> Absolute (dBm) <input type="text" value="-90.0"/> <input type="button" value="Set Threshold"/> <input type="button" value="Reset Threshold"/>	<b>STC:</b> <input type="radio"/> 2 km <input checked="" type="radio"/> 3 km <input type="radio"/> 4 km	<b>Mouse-Control:</b> Scan Nr.: <input type="text"/> Scantime (s): <input type="text"/> Distance Cell: <input type="text"/> Distance (m): <input type="text"/> Height (m): <input type="text"/>	<b>Level-Control:</b> 
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No. of echos detected:



Wingbeat freq.:

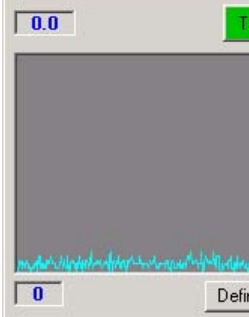
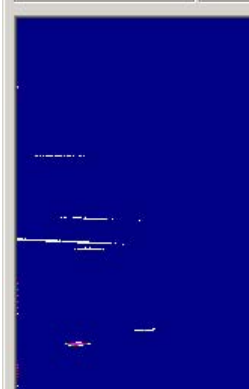
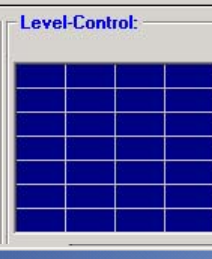
**General:**  
 Radar-Site:   
 Date:   
 Time:   
 Threshold:   
 Offset:   
 VSU:

**Antenna position:**  
 Elevation (CMD):   
 Elevation Start:   
 Elevation Stop:   
 Elevation Offset:   
 Azimuth (CMD):   
 Azimuth Start:   
 Azimuth Stop:

**Threshold-Control:**  
 Synthetic   
 Absolute (dBm)

**STC:**  
 2 km  
 3 km  
 4 km

**Mouse-Control:**  
 Scan Nr.:   
 Scantime (s):   
 Distance Cell:   
 Distance (m):   
 Height (m):



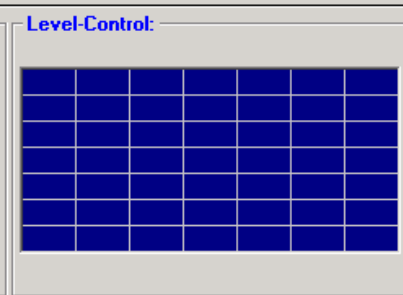
**General:**  
 Radar-Site:   
 Date:   
 Time:   
 Threshold:   
 Offset:   
 VSU:

**Antenna position:**  
 Elevation (CMD):   
 Elevation Start:   
 Elevation Stop:   
 Elevation Offset:   
 Azimuth (CMD):   
 Azimuth Start:   
 Azimuth Stop:

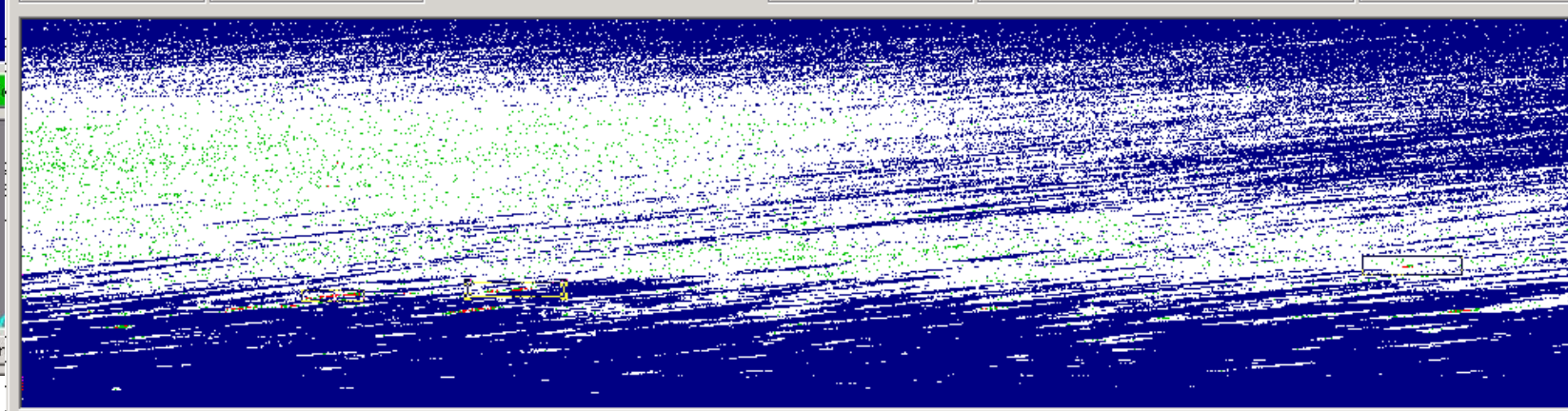
**Threshold-Control:**  
 Synthetic   
 Absolute (dBm)

**STC:**  
 2 km  
 3 km  
 4 km

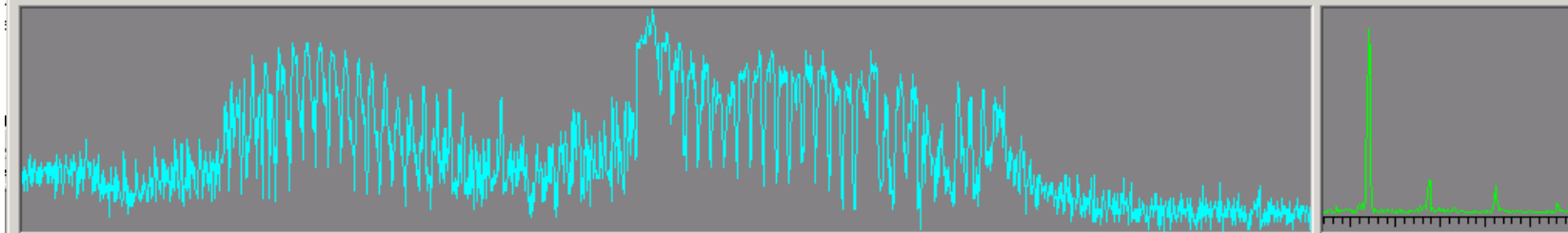
**Mouse-Control:**  
 Scan Nr.:   
 Scantime (s):   
 Distance Cell:   
 Distance (m):   
 Height (m):



- Data files:**
- M-030914-2000.FF1 ▲
  - M-030914-2005.FF1
  - M-030914-2010.FF1
  - M-030914-2020.FF1
  - M-030914-2025.FF1
  - M-030914-2030.FF1
  - M-030914-2040.FF1
  - M-030914-2045.FF1
  - M-030914-2050.FF1
  - M-030914-2100.FF1 ▼



1:1 1:2 1:4 1:8 1:16 No. of echos detected:



Wingbeat freq.:



## Possible targest in fixed beam data

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- single bird (small – large)
- flock of birds
- single insect
- swarm of insects
- UFO's
- clouds
- clutter, noise



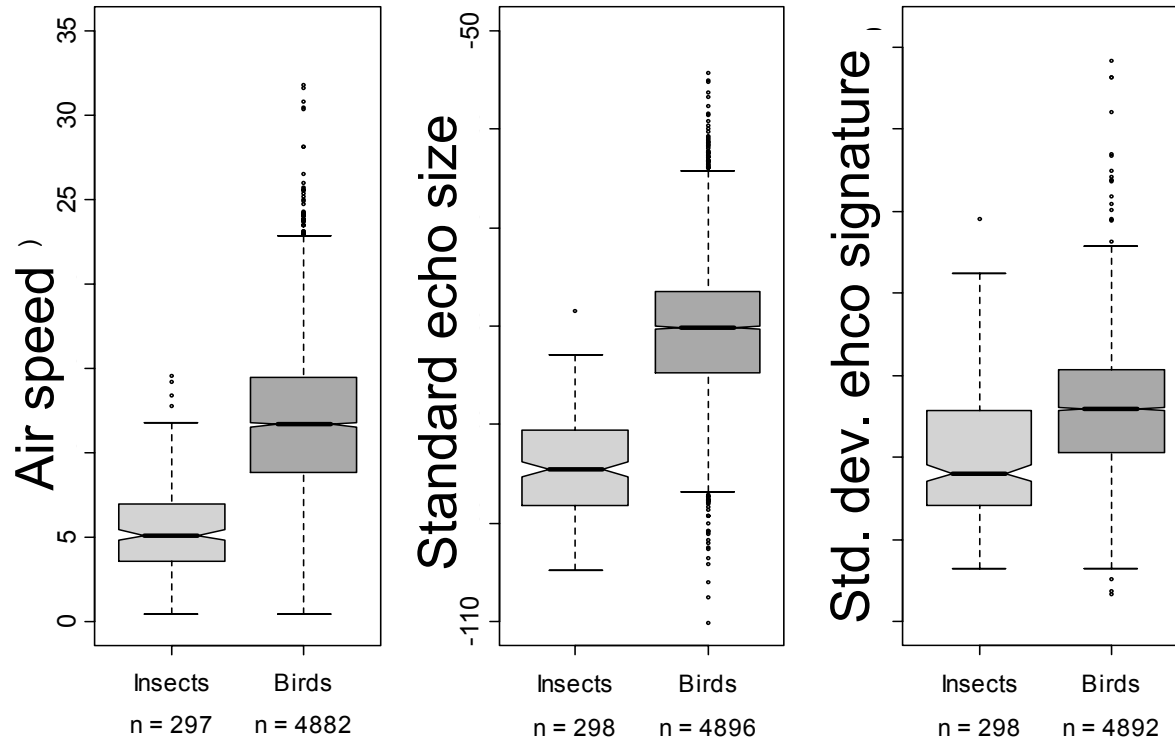
## Available information from fixed beam data

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- mean echo intensity
- echo length (duration)
- distance
- echo signature  
(variation of echo  
intensity in time)



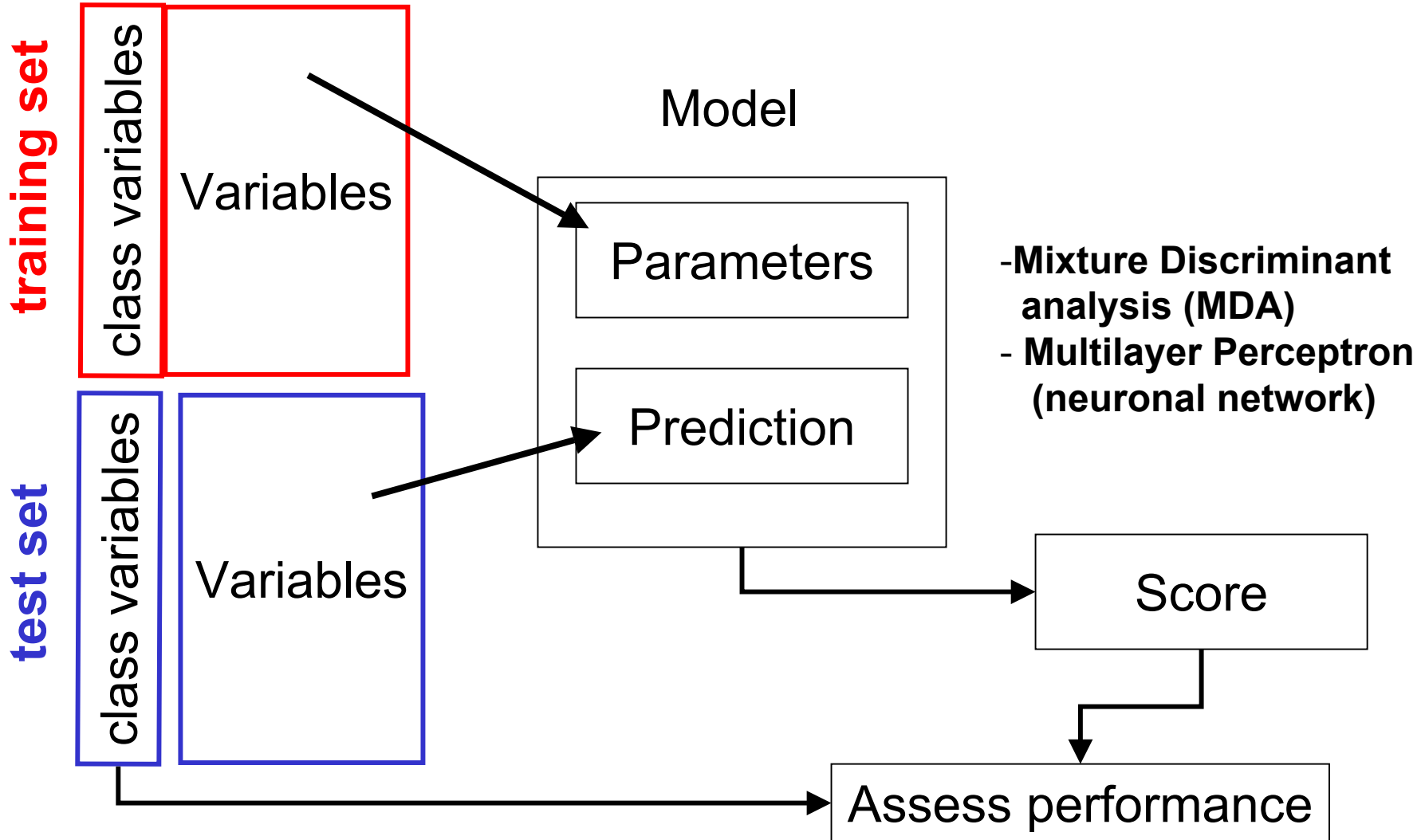
# Automatic identification







# Supervised classification of radar signals







# Performance

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## Input

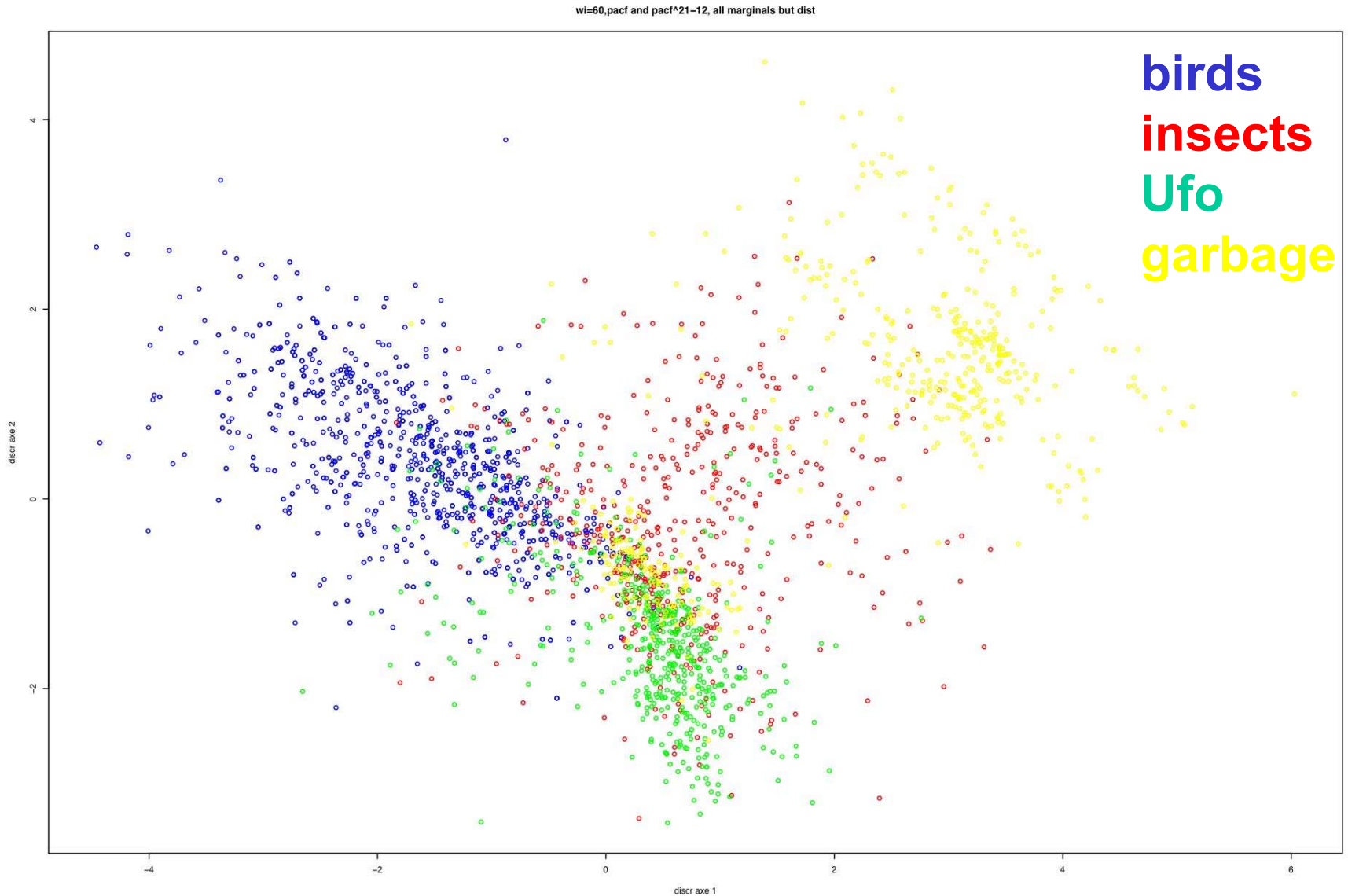
- 46 variables
- 37285 echoes classified by an expert (from 1 site)
- only 2500 used due to restricted computation facilities.

## Results

- 44 variables selected with MDA
- 14 variables selected with MLP
- with a positive predictive value of 98% and a false negative rate of 2% the models (MDA and MLP) allowed to classify **82% (86%)** of the targets properly.  
With a threshold of 95% and 5%, **98%** could be classified.

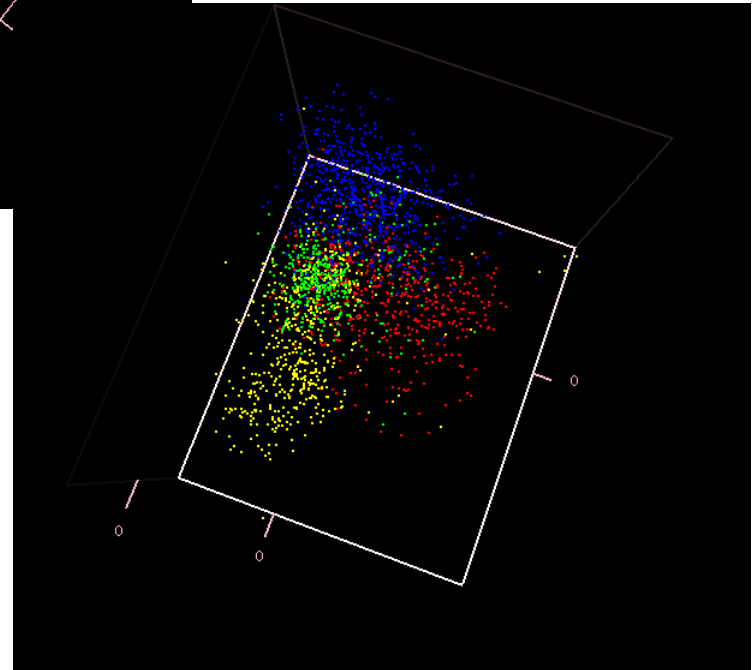
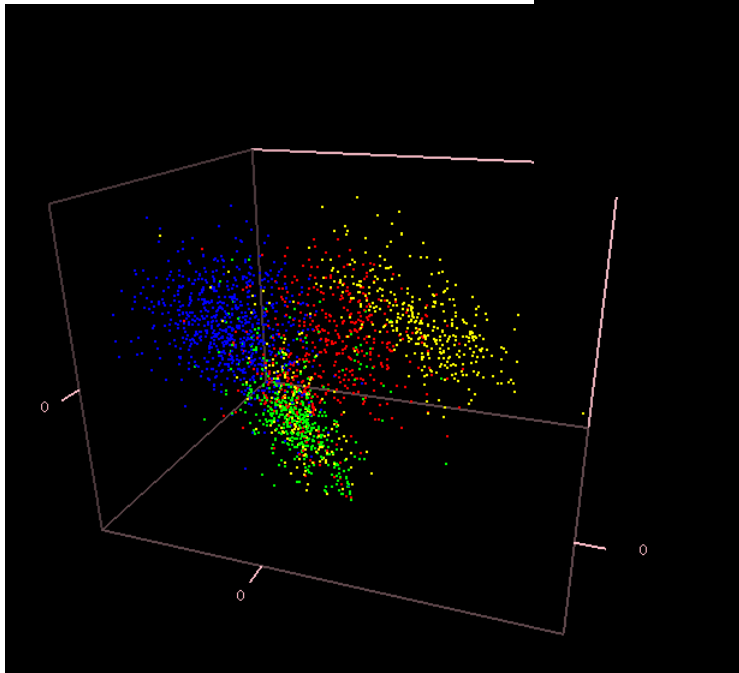
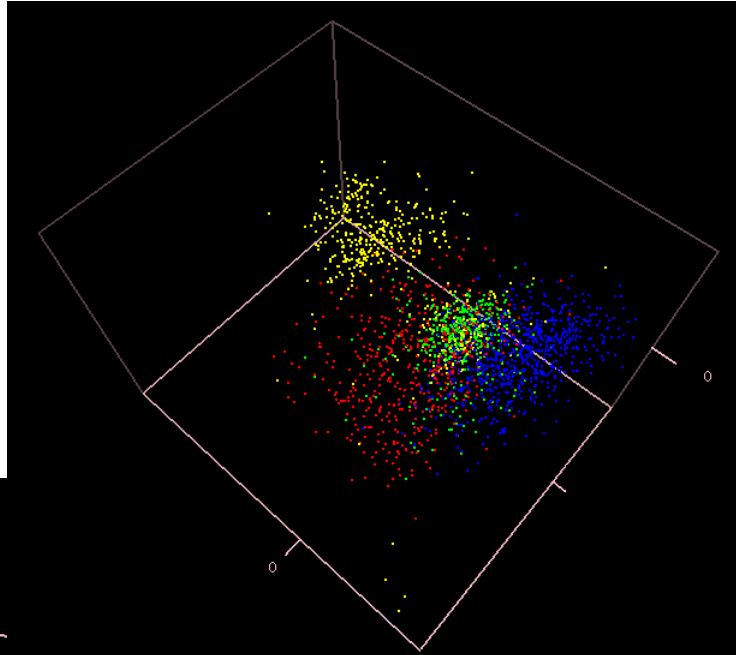


# 2 D view of two linear discriminant axes





# 3 D view on three linear discriminant axes





## Future work

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- tuning the algorithm with more data
- applying it to samples from other sites
- implementing the algorithm in the echo detection software to achieve automatic detection of birds versus non-birds
- investigate an algorithm to distinguish between the birds (passerine – wader – swift).

