Species Identification Update

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Species Identification

Literature Update:

– Software
  • LSSS

– Analysis methods
  • Automation
  • Identification of coexisting species using multi-frequency, cluster analysis, school morphology, school location, echo statistics, etc.

– Technology/instrument related
  • Broadband, cameras, DIDSON
Large Scale Survey System (LSSS) software

- Utilizes multi-frequency information for species discrimination.
- Used for post-processing like Echoview.
- Automated
- Results in real-time (Rapid)

Korneliussen et al. 2006
Analysis Methods for Species ID

• School morphology
• Classification trees
• Generalized Gaussian Mixture model (GGMM)
• Kernel clustering
• Support Vector Machines (SVM) & Neural Networks
• statistical-spectral method for target identification (SSID)
• MVBS (Sato)
• Probabilistic Clustering
Species Identification based on school morphology using LSSS

• Distinguish species with similar acoustic properties, provided they occur in monospecific schools using:

  – morphological properties of schools and...
  – the geographical distribution of fish
Classification Trees

- MVBS
- Mean Depth

Fernandes 2009
Confusion Matrix

- A **confusion matrix** is a table that is used to describe the performance of a classification model (or "classifier") on a set of test data for which the true values are known.

<table>
<thead>
<tr>
<th>Tree scrutiny</th>
<th>Herring</th>
<th>Layer</th>
<th>Mackerel</th>
<th>Mycto</th>
<th>Agree. rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Definitely herring</td>
<td>1043</td>
<td>0</td>
<td>58</td>
<td>12</td>
<td>0.94</td>
</tr>
<tr>
<td>Probably herring</td>
<td>1845</td>
<td>52</td>
<td>46</td>
<td>5</td>
<td>0.95</td>
</tr>
<tr>
<td>Possibly herring</td>
<td>0</td>
<td>6</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td>Surface herring</td>
<td>474</td>
<td>8</td>
<td>16</td>
<td>1</td>
<td>0.95</td>
</tr>
<tr>
<td>Mackerel</td>
<td>22</td>
<td>3</td>
<td>5</td>
<td>0</td>
<td>0.17</td>
</tr>
<tr>
<td>UnID</td>
<td>469</td>
<td>42</td>
<td>48</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>?</td>
<td>31</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Total agreed</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.80</td>
</tr>
<tr>
<td>Mackerel and herring</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.75</td>
</tr>
</tbody>
</table>

Fernandes 2009
Generalized Gaussian Mixture Model

- Species-specific pairwise frequency differences
- Each known class is assumed to follow a Gaussian distribution
- Can identify unknowns

Woillez et al 2009
Kernel Clustering

• Data are transformed into an abstracted representation by multidimensional nodes
• combined components used to determine clusters (identifying species) based on joint spatial, temporal, and acoustic similarities.

Buelens et al 2009
Support Vector Machines & Neural Networks

- Neural Networks: Heuristic tool for recognizing patterns or discriminating between two groups
- SVM: Learns by example... Seeks separation hyperplanes in space.
- SVM uses descriptors of morphology, bathymetry, energy, and position for schools

Robothem et al 2010
Statistical-spectral method for target identification (SSID)

- Uses information contained in both the signal amplitudes and phases.
- The SSID uses multifrequency echo statistics from individual time-space intensities (pixels)
- Used to identify general scattering types before applying model-based identification schemes for target identifications
- Good for distinguishing between the bottom and demersal fish

Demer et al. 2009
References


