Smart Annotation GUI For Monitoring Bird Migration

Liming Wang (lwang114@illinois.edu)
Mentor: Jia-Bin Huang (jbhuang1@Illinois.edu)

Department of Electrical and Computer Engineering, University of Illinois at Urbana Champaign

Develop an annotation Graphical User Interface to help ornithologists to recognize and collect accurate data of migration birds at night from extremely noisy videos due to low-light condition.

Challenges
- Very small target (1-2 pixels)
- Noisy videos due to low-light
- Motion is the only reliable cue

Methods
Bird Trajectory Modeling
- Estimate velocity of the birds: 3-D least square line fitting by maximizing Raleigh quotient
- Predict the position of the birds in the next frame:
  \[
  \begin{bmatrix}
  x' \\
  y'
  \end{bmatrix} = \begin{bmatrix}
  x_0 \\
  y_0
  \end{bmatrix} + \begin{bmatrix}
  v_x \\
  v_y
  \end{bmatrix} t
  \]

  Estimate altitude: stereo camera mode:
  \[
  z = \frac{f B}{x_{east} - x_{west}}
  \]

Automatic Detection Algorithm
- Altitude: 200 - 1400 meters
- Speeds: 10 - 30 meters per second
- The majority of the birds heading North-East direction.

Statistics

<table>
<thead>
<tr>
<th>Statistics of annotated birds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Altitude Speed Direction</td>
</tr>
<tr>
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</table>

Related Work
- Bird monitoring using weather radar or satellite
- Moon watching
- Small target detection
- RANSAC and Hough transform technique

Applications
- Calibrate radar reflectivity
- Bird forecasting to protect endangered bird species from potential threats
- More accurate groundtruth data to study long-term climate change

Goal

Related Work

GUI Implementation

Statistics

Results

Annotation Samples

Our smart annotating GUI is capable of annotating multiple birds and narrow down the bird target as more points are clicked.