Innovations II: Fishcam: A Video Based Monitoring System for Fish Passes

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FISHCAM
A VIDEO BASED MONITORING SYSTEM FOR FISH PASSES

FISHPASSAGE 2016
University of Massachusetts Amherst

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Content

• Development of FishCam (Hardware)
• Development of FishDef (Software)
• Trap vs. FishCam Monitoring
• Conclusion & Discussion
FishCam

WHY
- non contact monitoring of migrating fish
- low cost and low personal effort
- evaluation of functionality of measures

WHERE
- fish passes
- fish sensible areas of HPP (fine screen)

HOW
- video, remote monitoring and online reports
Components

- LAN surveillance camera
- IP 68 waterproof case
- housing (fresh water)
- LED lightning
- detection tunnel
- white back panel
- structured floor
- mirror cover
- wireless router
- NAS storage 2TB
Camera & light

- AXIS P1357-E
- 5 mpx, HDTV at 12 fps
- THEIA SL183 vario-focal ultra wide lens
- focal length 1.8-3 mm
- INON 125 mm dome port

- 5 m LED Stripes, 4500 lumen 6000 K
Detection tunnel

- Cross section 0.5 / 0.35 / 0.25 X 1.0 m
- $V_{\text{mean}}$ 0.4 – 0.7 m/s

<table>
<thead>
<tr>
<th>Depth</th>
<th>back</th>
<th>middle</th>
<th>camera</th>
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<tbody>
<tr>
<td>80%</td>
<td>0.55</td>
<td>0.70</td>
<td>0.49</td>
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<tr>
<td>60%</td>
<td>0.70</td>
<td>0.62</td>
<td>0.53</td>
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<tr>
<td>20%</td>
<td>0.68</td>
<td>0.52</td>
<td>0.41</td>
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<tr>
<td>$V_{\text{mean}}$</td>
<td>0.64</td>
<td>0.61</td>
<td>0.48</td>
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</table>

Fishpass flow 415 l/s
maintainance
Quality

School of Common bleak (Alburnus alburnus)

Pike (Esox lucius), clear water
FishCam & FishDef Monitoringsystem

FishDef

WHAT
- separating fish from non-fish moving objects
- classification of migration direction
- automatically length classification in clear water

WHERE
- clear and turbid water

HOW
picture separation (background, object) — object tracking — object classification

FishPassage 2016, Massachusetts
Segmentation

a) Background model
b) Object in video
c) "similarity matrix", from (a) and (b)
Segmentation

Histogram of intensity of pixels with threshold value (Otsu 1979)

Object mask

FISHPASSAGE 2016, Massachusetts
Object tracking

Problem: schools
FishDef Classifier (Kratzert 2016)

Object classification

- Object segmentation & detection
- Object tracking
- Objects compared with fishmodel
  - a) 225 fish-masks → b) Mean fish form
- Single image stored
FishDef Classifier (Kratzert 2016)

Object classification in fish/no fish (Kratzert 2016)
- color parameter (e.g. mean color value in color ribbons), texture parameter (e.g. repeating pattern neighboring pixel), shape parameter (e.g. length/width proportion, roundness, rectangularity etc.)
FishDef Classifier (Kratzert 2016)

- automate detection isFish / noFish
- Detection rate > 90%
- Fine tuned (38870 images)
- 70/10/20 for training/validation/testing

<table>
<thead>
<tr>
<th>True Class</th>
<th>Predicted Class</th>
<th>Precision</th>
<th>Sensitivity</th>
<th>Specificity</th>
<th>Accuracy</th>
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<tbody>
<tr>
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<td>No-Fish</td>
<td>3490</td>
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</tr>
</tbody>
</table>

F1-Score = 0.96
Conclusions

- fish migration recorded without contact and stress
- upstream and downstream
- time
- reduction of field work from twice a day to every 1 - 2 weeks
- 95% of correctly classified objects
- length classification at good visibility
- 1,000,000 videos → 3% fish videos
Thank you for your attention ...