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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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Kulturtechnik, Ökologie
& Rechtsgutachten mbH*
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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)

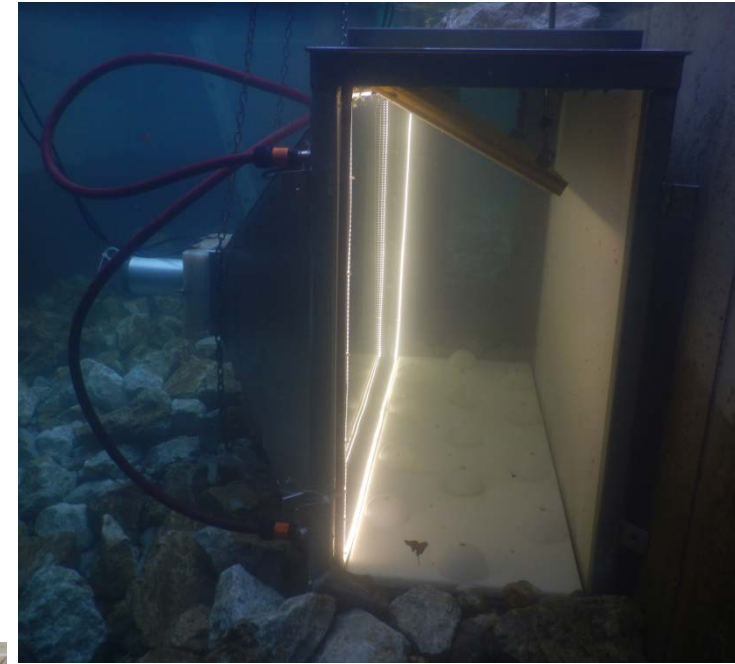
HOW

- 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_{mean} 0.4 – 0.7 m/s**

Fishpass flow 415 l/s

Depth	back	middle	camera
80%	0.55	0.70	0.49
60%	0.70	0.62	0.53
20%	0.68	0.52	0.41
V_{mean}	0.64	0.61	0.48



Settings

AXIS P1357 Network Camera Live View | Setup | Help

- Basic Setup
- Video & Audio**
 - Video Stream
 - Stream Profiles
 - Camera Settings
 - Overlay Image
 - Privacy Mask
 - Focus
 - Audio Settings
 - Audio Clips
- Live View Config
- Detectors
- Applications
- Events
- Recordings
- System Options
- About

Video Stream Settings

Image Appearance

Capture mode: SMP 2592x1944 (4:3)
 Resolution: 2592x1944 (4:3) pixels
 Compression: 30 [0..100]
 Mirror image
 Rotate image: 0 degrees

Video Stream

Maximum frame rate:
 Unlimited
 Limited to [] fps per viewer

Overlay Settings

Include overlay image at the coordinates: X 0 [0..] Y 0 [0..]
 Include date Include time
 Include text: []
 Text color: white Text background color: black
 Place text/date/time at top of image

Preview

View image stream while configuring. Video format: MJPEG

AXIS P1357 Network Camera Live View | Setup | Help

- Basic Setup**
 - Instructions
 - 1 Users
 - 2 TCP/IP
 - 3 Date & Time
 - 4 Video Stream
 - 5 Focus**
 - 6 Audio Settings
- Video & Audio
- Live View Config
- Detectors
- Applications
- Events
- Recordings
- System Options
- About


Focus

Basic **Advanced**

to default back focus position.

Focus position: Near << < [] > >> Far

Focus is measured in the adjustable focus window below



AXIS P1357 Network Camera Live View | Setup | Help

- Basic Setup
- Video & Audio
- Live View Config
- Detectors
- Applications
- Events
- Recordings**
 - List
 - Continuous
- System Options
- About

Recording List

Filter

Recording time:
 From: First recording [] (yyyy-mm-dd hh:mm)
 To: Now 2016-01-29 16:19 (yyyy-mm-dd hh:mm)
 Event: Any
 Storage: Any
 Sort: Descending
 Results: Max 20 recordings at a time

Recording 1 to 20 of 93

Start date & time	Duration	Event
2016-01-29 14:35:59	00:00:07	Motion
2016-01-29 14:24:34	00:00:06	Motion
2016-01-29 12:54:17	00:00:07	Motion
2016-01-29 09:21:37	00:00:07	Motion
2016-01-29 09:15:16	00:00:07	Motion
2016-01-29 07:50:09	00:00:07	Motion
2016-01-29 07:21:15	00:00:12	Motion



maintenance

AXIS P1357 Network Camera Live View | Setup | Help

Motion Detection

View in: 640x480

Basic Setup

Video & Audio

Live View Config

Detectors
Camera Tampering
Motion Detection
Audio Detection

Applications

Events

Recordings

System Options

About

Motion Detection

Add Window

0 1

Include Exclude

Fisch

Object Size

History

Sensitivity

Activity

Save

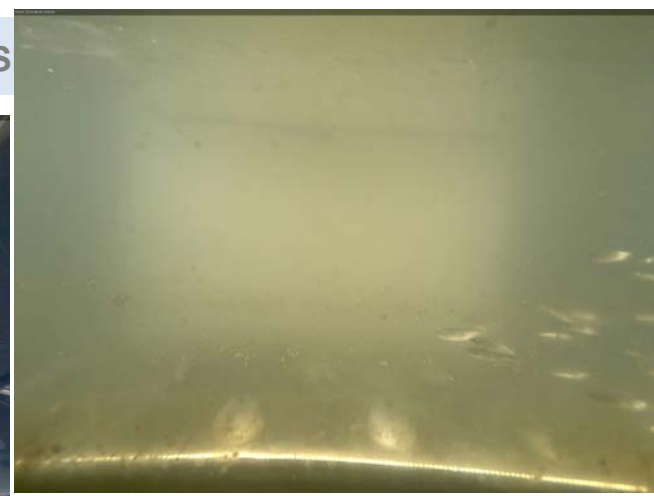
View All Windows
 View Selected Window

Video

Stop Play 1 fps



Quality



School of Common bleak (*Alburnus alburnus*)



Pike (*Esox lucius*), clear water



FishDef

WHAT

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

WHERE

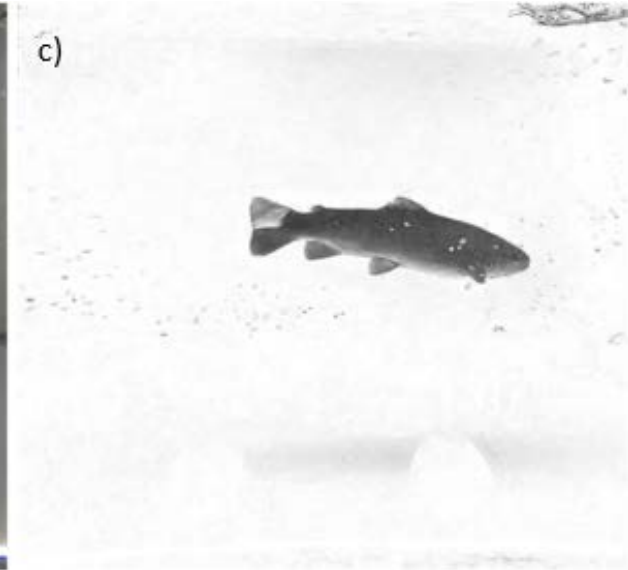
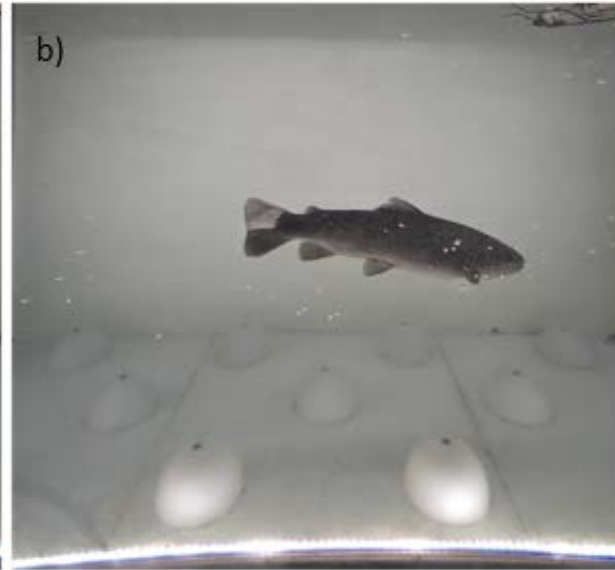
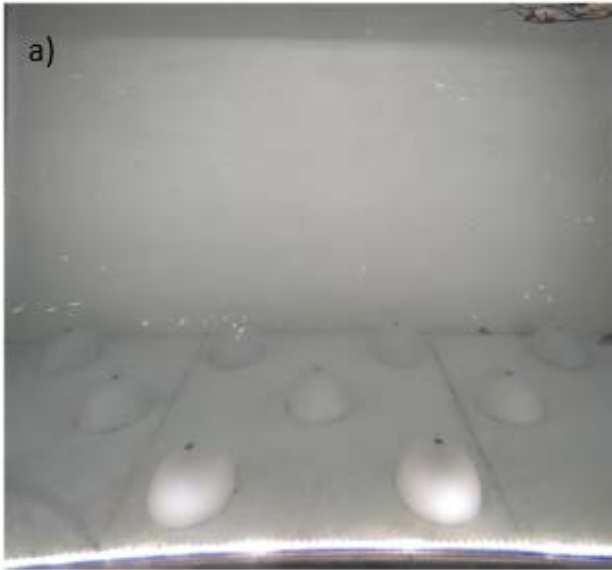
- clear and turbid water

HOW

- picture separation (background, object) –
- object tracking – object classification



Segmentation

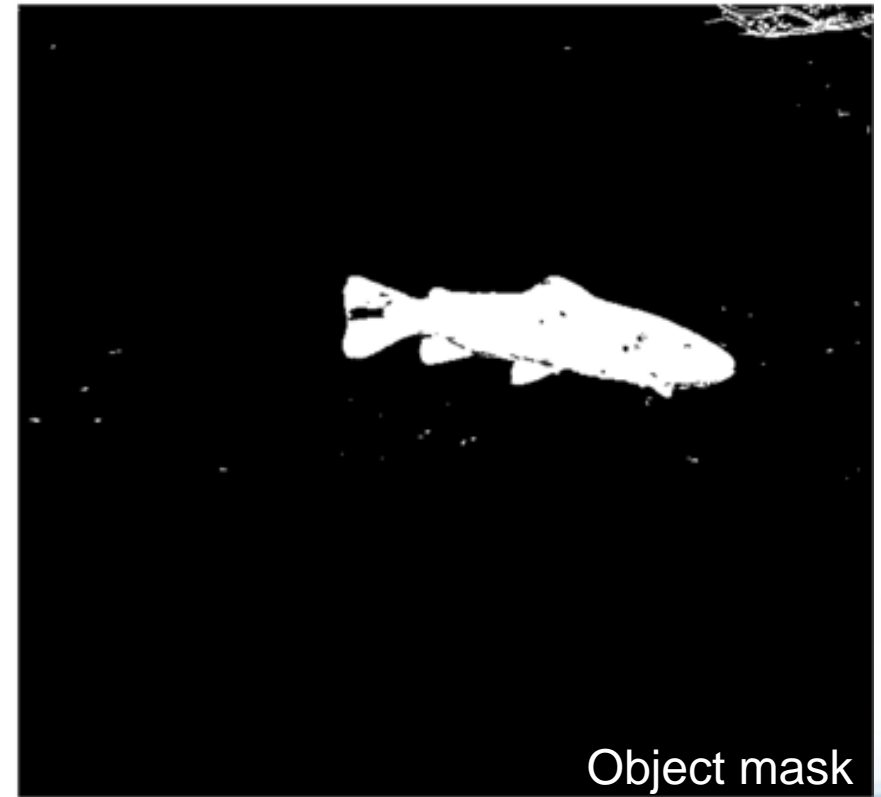
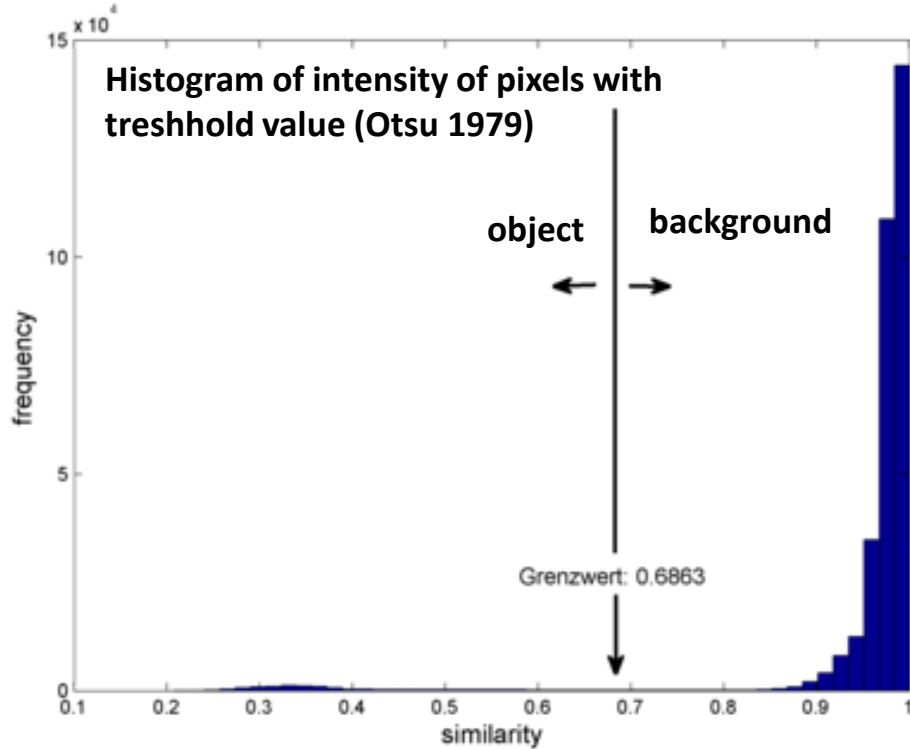


a) Background model

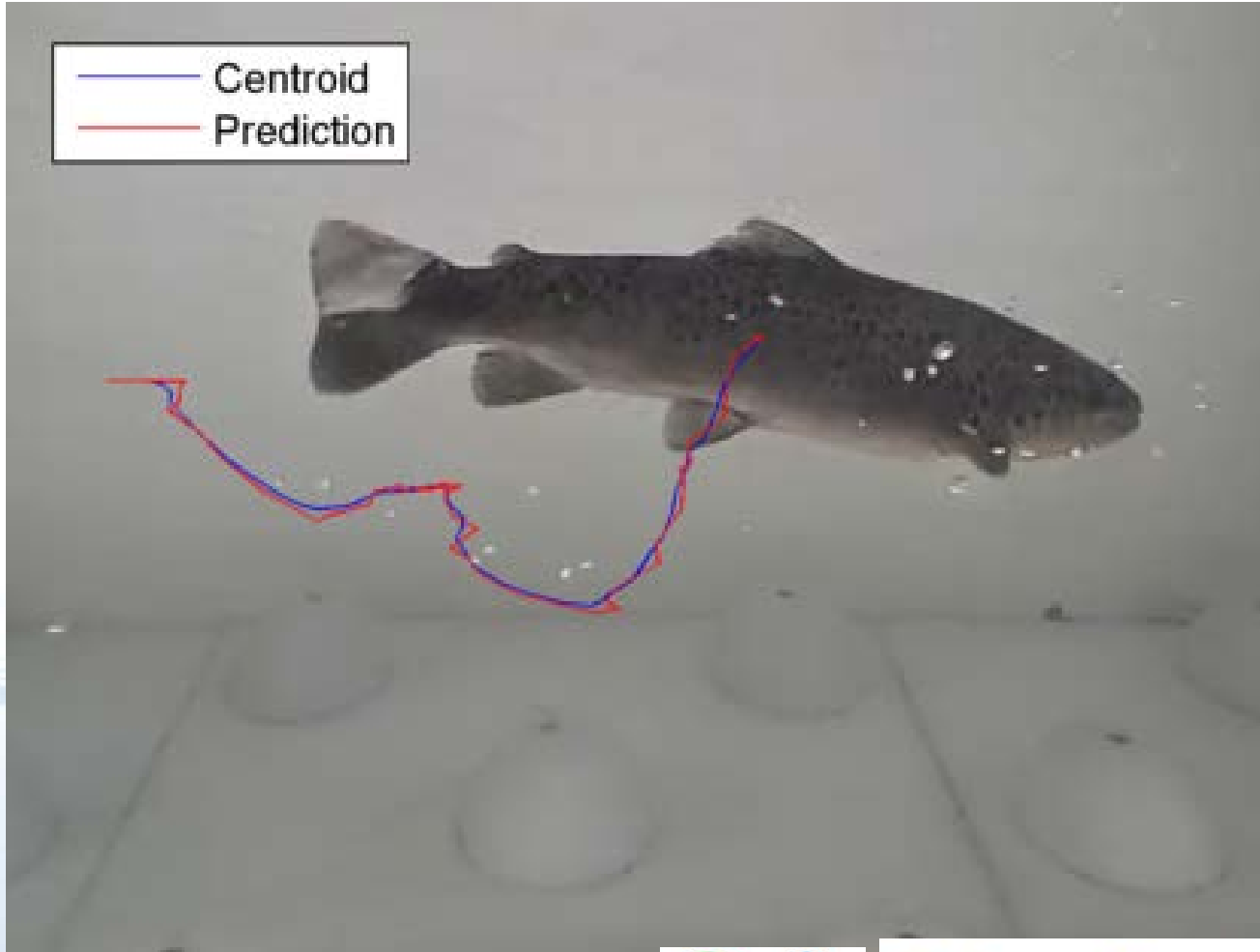
b) Object in video

**c) "similarity matrix,,
from (a) and (b)**

Segmentation



Object tracking



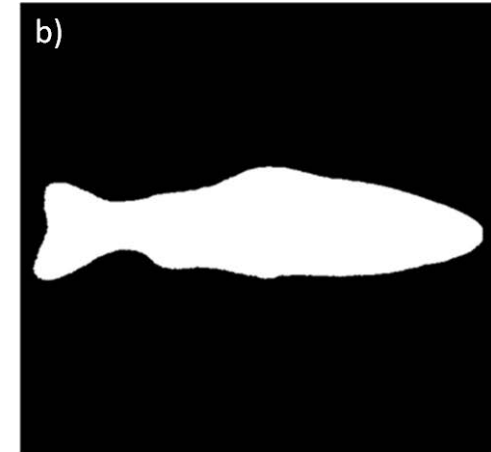
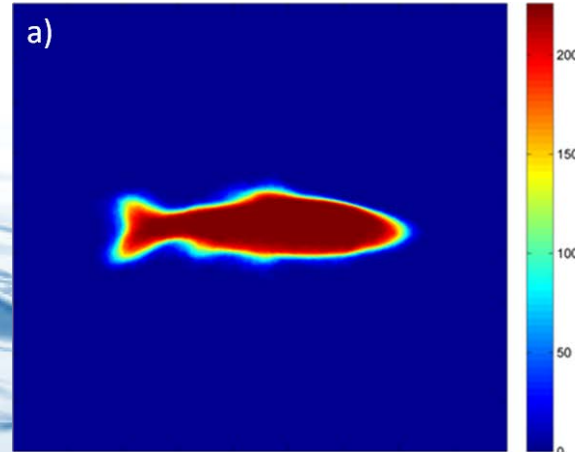
Problem: schools



FishDef Classifier (Kratzert 2016)

Object classification

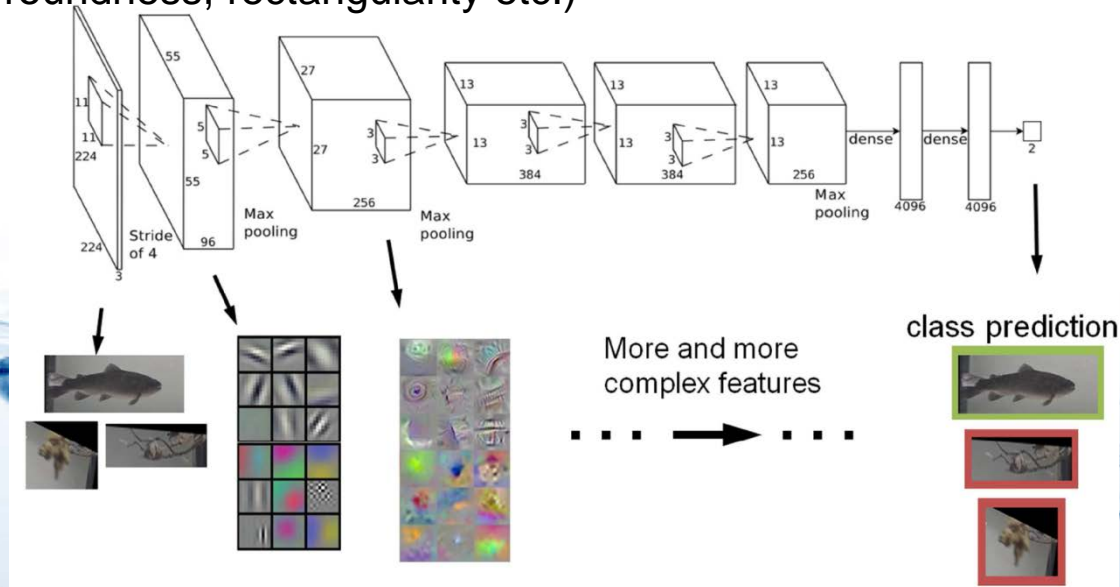
- Object segmentation & detection
- Object tracking
- Objects compared with fishmodel
 - a) 225 fish-masks → b) Mean fish form
- Single image stored



FishDef Classifier (Kratzert 2016)

Object classification in fish/no fish (Kratzert 2016)

- pretrained and fine-tuned Deep Convolutional Network (A. Krizhevsky, I. Sutskever 2012 in 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

		Predicted Class		
		Fish	No-Fish	
True Class	Fish	3886	221	<i>Precision = 0.95</i>
	No-Fish	177	3490	<i>Neg. precision value = 0.95</i>
		<i>Sensitivity = 0.96</i>	<i>Specificity = 0.94</i>	<i>Accuracy = 0.95</i>
<i>F1-Score = 0.96</i>				

(Kratzert 2016)

Breams & Nase

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 visability
- 1.000,000 videos → 3% fishvideos



Thank you for your attention ...



QUESTIONS



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