CHUTE BASED AUTOMATED FISH LENGTH MEASUREMENT AND WATER DROP DETECTION

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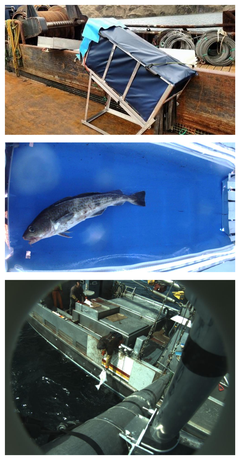
INTRODUCTION

- **Electronic monitoring (EM) system on federal fisheries**
  - Segmentation
  - Measurement
  - Species
- **Challenges**
  - Live fish may deform freely
  - Camera can be splashed by water
- **Contribution of this work**
  - Morphological midline
  - Water drop detection



SYSTEM OVERVIEW

➢ **Automated chute-based fish measurement system**

Input image

Projective transform to de-skew the fish image

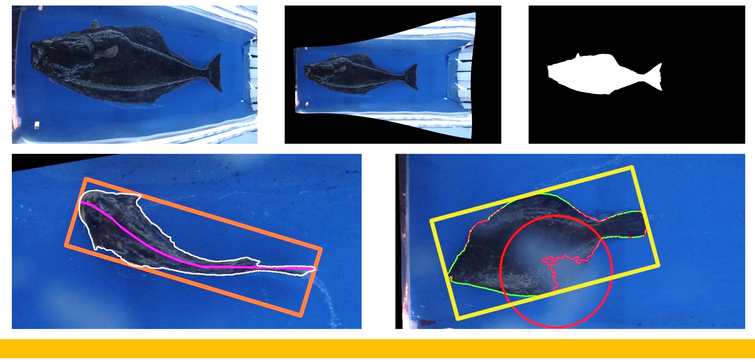
Foreground segmentation using GMM

Recursive morphological operation

Midline points and measurement

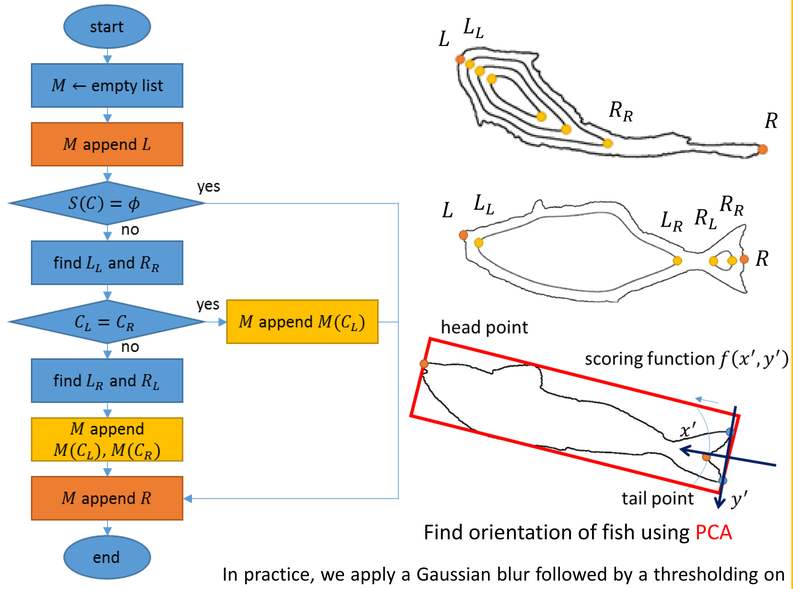
Image gradient and sharpness on contour

Blur measure and water drop detection



MORPHOLOGICAL MIDLINE

- Locate head and tail endpoints
- Do recursive morphological operation to generate midline points



Find orientation of fish using PCA

In practice, we apply a Gaussian blur followed by a thresholding on the fish mask to approximate the morphological erosion.

WATER DROP DETECTION

- **Sharpness** ∝ image gradient:

$$m(x) = \frac{\|\nabla z(x)\|_2}{z(x)}$$

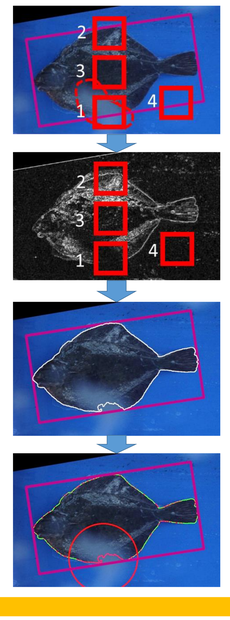
- Separate the contour points in C into:
  sharp points, $S = \{x \in C | m(x) > \theta_T\}$
  blurry points, $B = \{x \in C | m(x) \leq \theta_T\}$
  ,where θ_T is the Otsu's threshold

- **Blur measure** ∝ (min density of S)$^{-1}$:

$$\text{blur}(C) = \frac{p_C(S)}{\min_{|h|=N} p_h(S)}$$

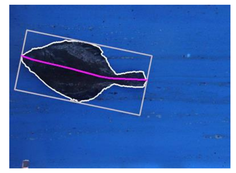
,where h is a contiguous window on C

- If $\text{blur}(C)$ is larger than a threshold, we conclude there is a water drop.

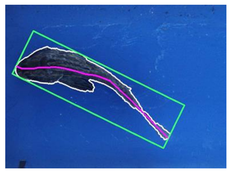


RESULTS

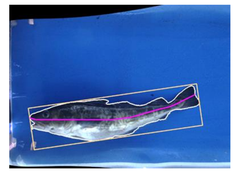
- **Morphological midline**



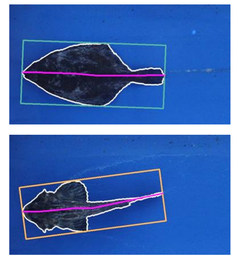
Different orientation



Curved body



Forked tail

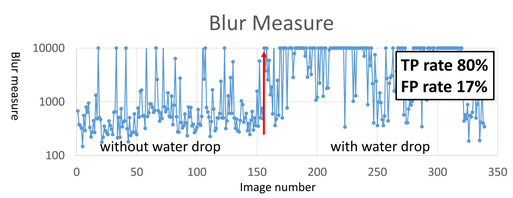


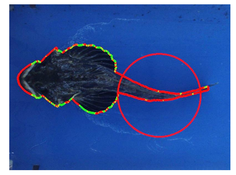
Straight body

Mean of Absolute Error of Different Species of Fishes

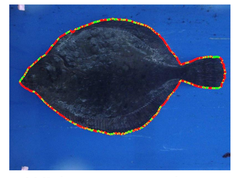
Species (number)	Box	[1]	Midline
Arrowtooth Flounder (722)	2.1%	1.6%	1.7%
Flathead Sole (450)	1.1%	1.2%	1.1%
Pacific Cod (282)	1.4%	1.1%	1.1%
Pacific Halibut (213)	3.8%	1.6%	**1.3%**
Pacific Ocean Perch (156)	5.5%	3.0%	**2.7%**
Rex Sole (178)	1.4%	1.5%	1.5%
Shortspine Thornyhead (210)	2.7%	1.9%	2.0%
Southern Rock Sole (316)	1.6%	1.7%	**1.5%**
Walleye Pollock (839)	2.3%	1.9%	**1.3%**
Yellow Irish Lord (71)	2.1%	1.8%	1.8%
Yellowfin sole (134)	1.5%	1.3%	**1.1%**
Total (3571)	2.14%	1.68%	**1.49%**

- **Water drop detection**

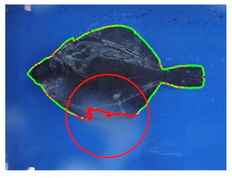




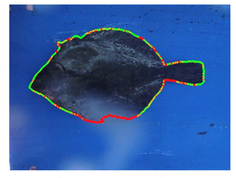
False positive



Without water drop



With water drop



False negative

ACKNOWLEDGEMENT

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REFERENCE

[1] D.J. White, C. Svellingen, and N.J.C. Strachan, "Automated Measurement of Species and Length of Fish by Computer Vision," *Fisheries Research*, vol. 80, pp. 203-210, 2006.