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Managing Water in the West

Developing Underwater Video Technology for Sampling Pelagic Delta Fishes.

"SmeltCam II"

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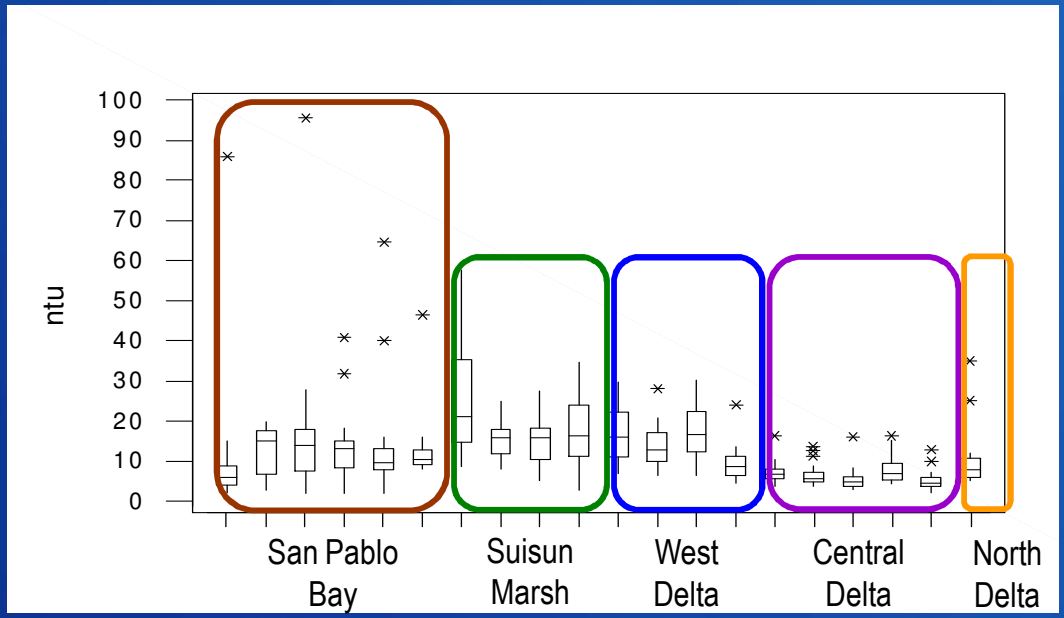
Objective: **Design a video imaging systems for sampling fish in turbid water that would compliment current population monitoring without harm.**

Turbidity data for different Delta regions
fall (September – December) 2000-2006



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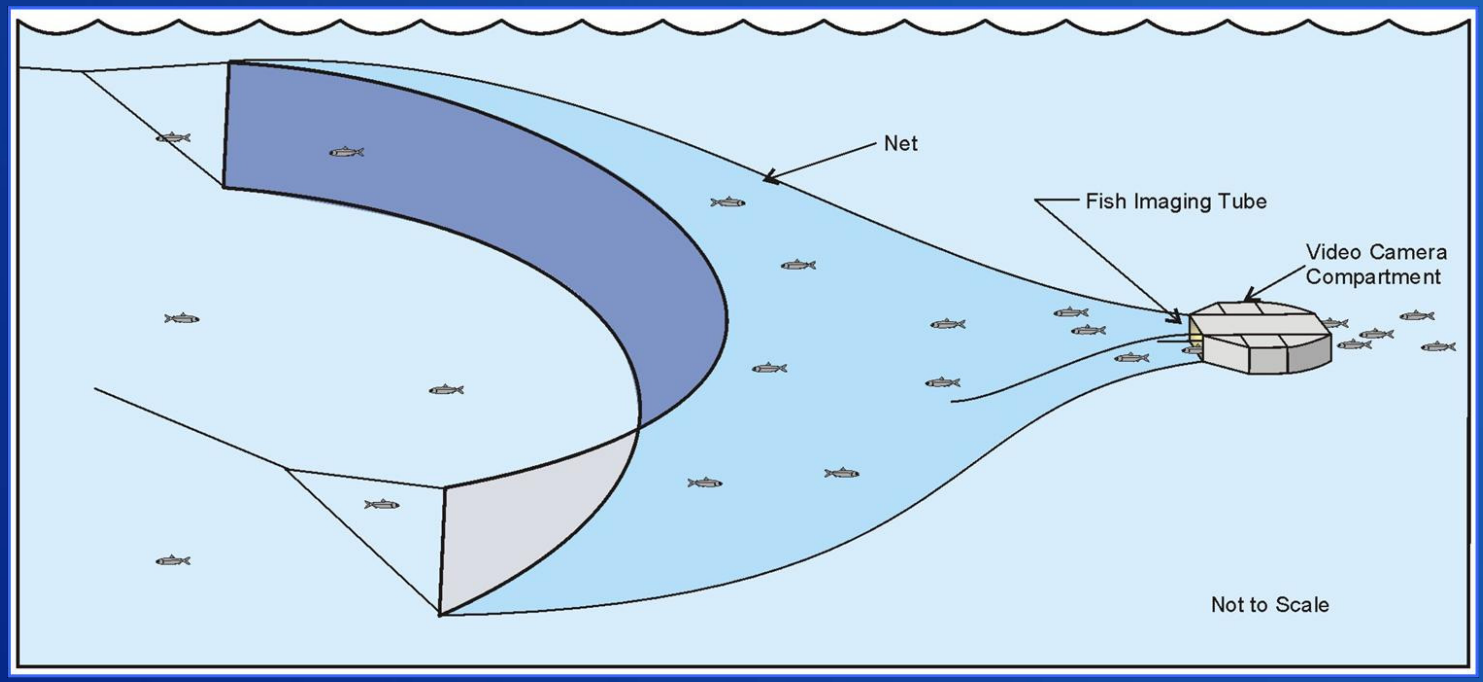
WHY?:

Long term sampling data have been exceptionally useful in detecting POD and monitoring population trends, additional sampling is necessary to gain further understanding of rare and patchy species' life histories



Underwater video technology could allow researchers to supplement current sampling without increasing lethal take of threatened and endangered species

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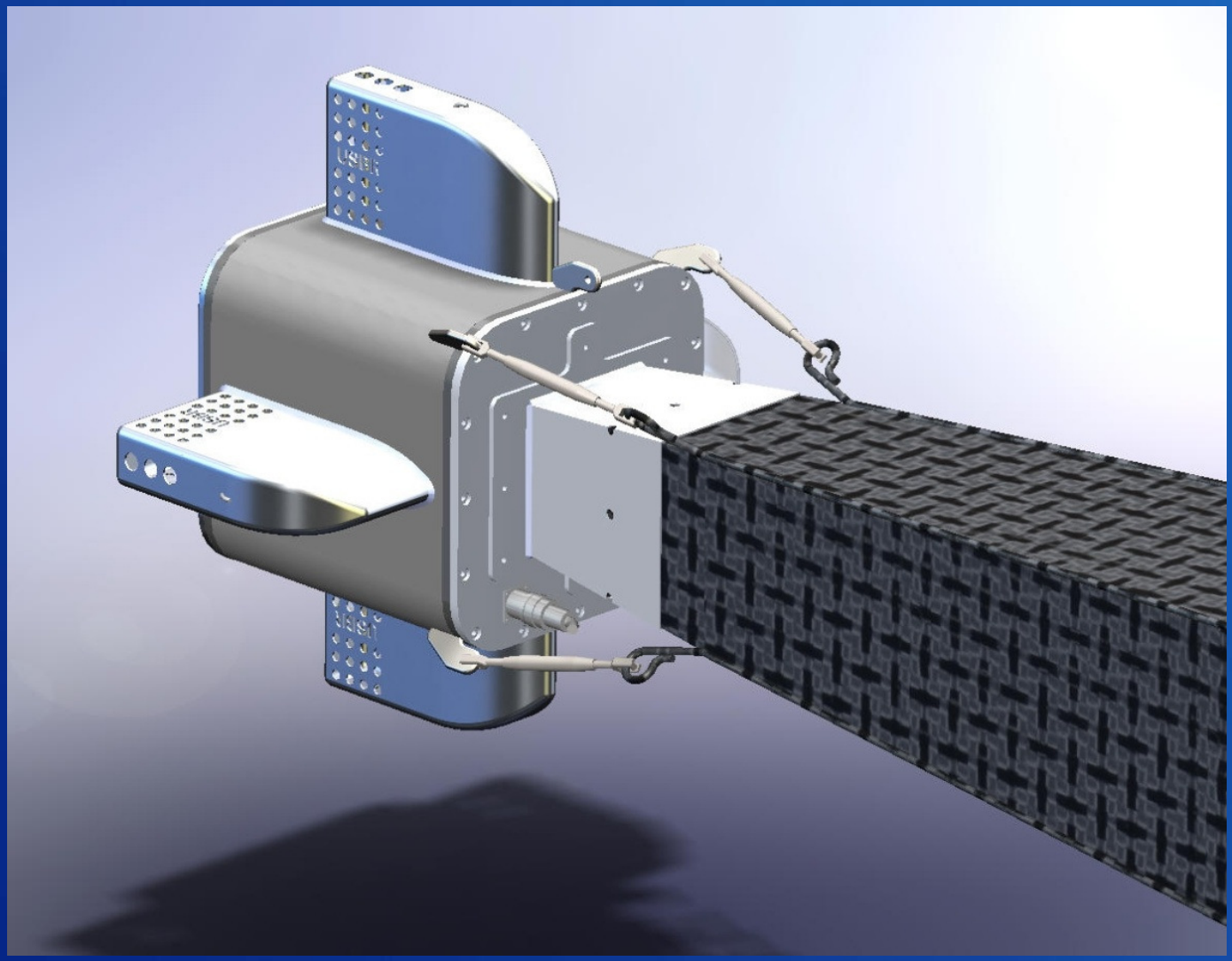
Smeltcam – Phase one



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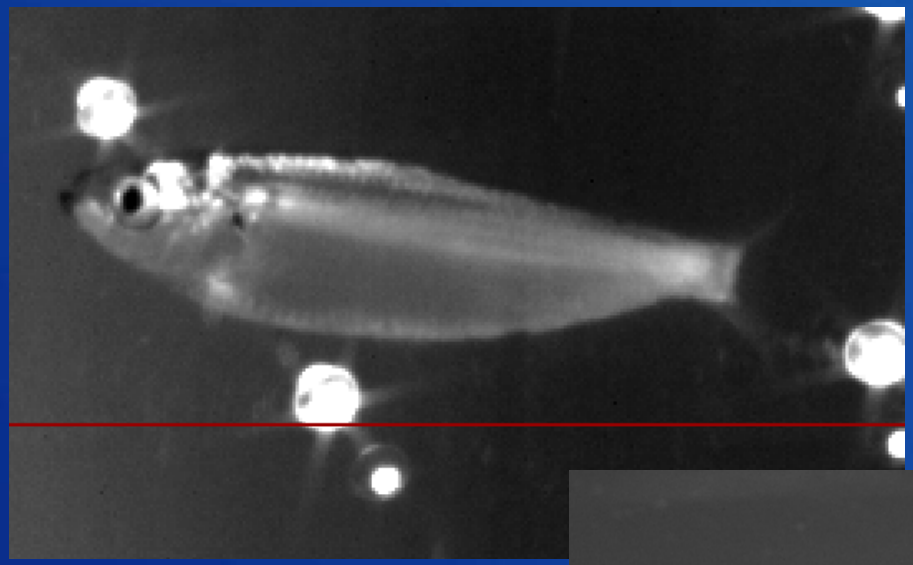
Smeltcam I: Field Test Image Samples



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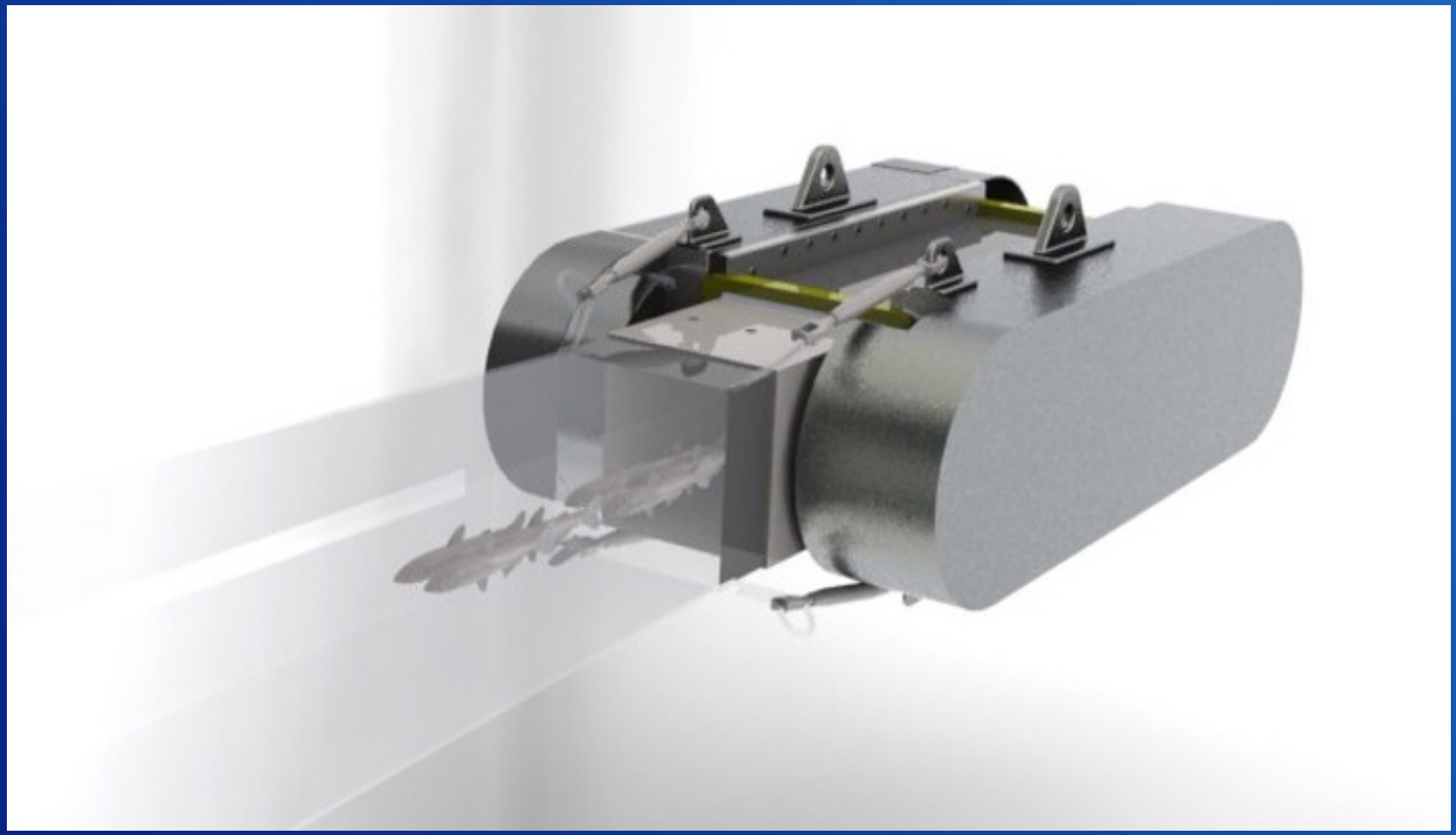
Smeltcam – Phase II



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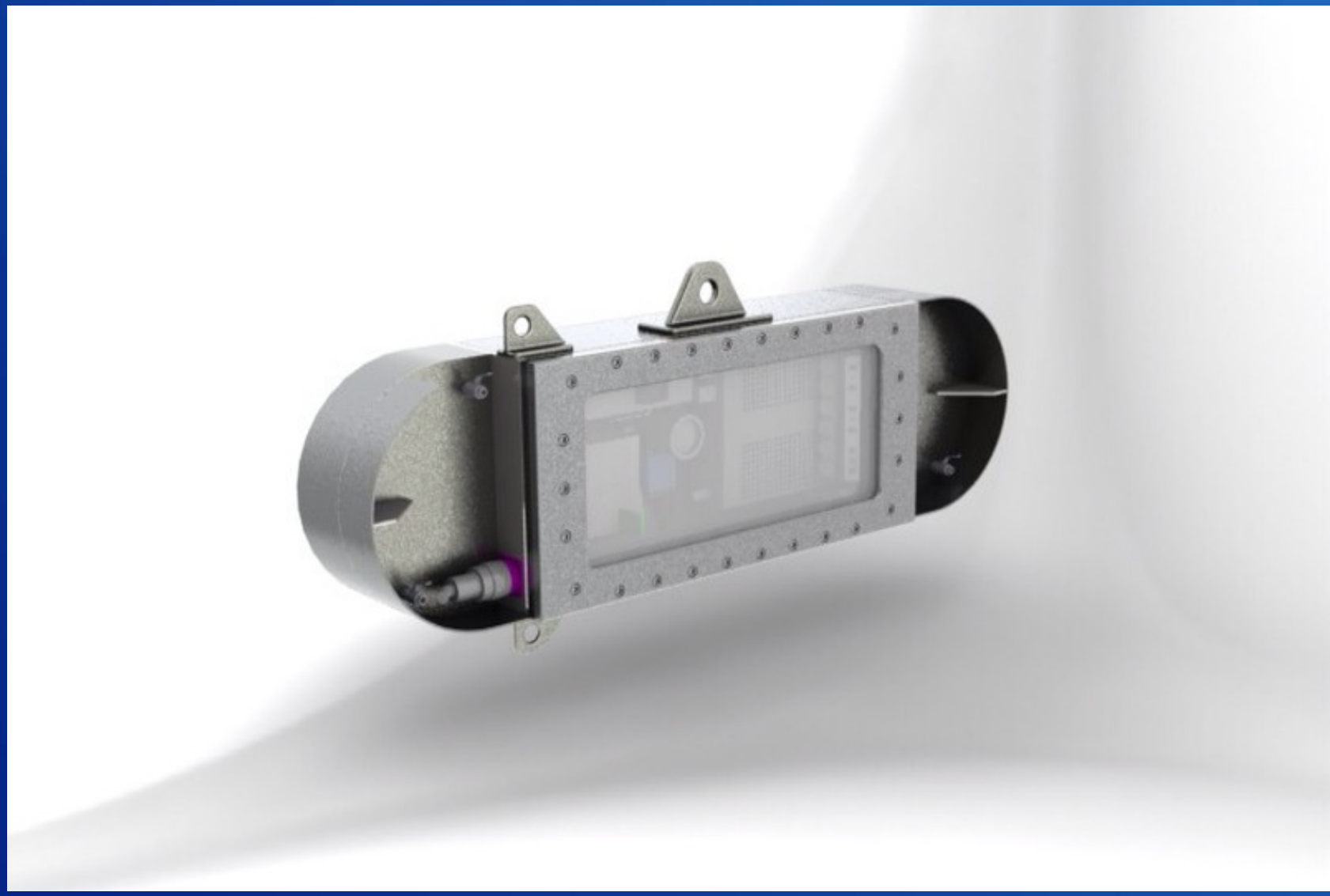
System overview

- ✓ Design decisions
  - ✓ Mechanical design
  - ✓ Electrical/Computing platform
  - ✓ Software system
- ✓ Future enhancements

Mechanical Design Considerations

- ✓Image quality first: form follows function
- ✓ Submersible, airtight, neutrally buoyant enclosure.
- ✓Displace least amount of water as possible, keep weight to minimum.



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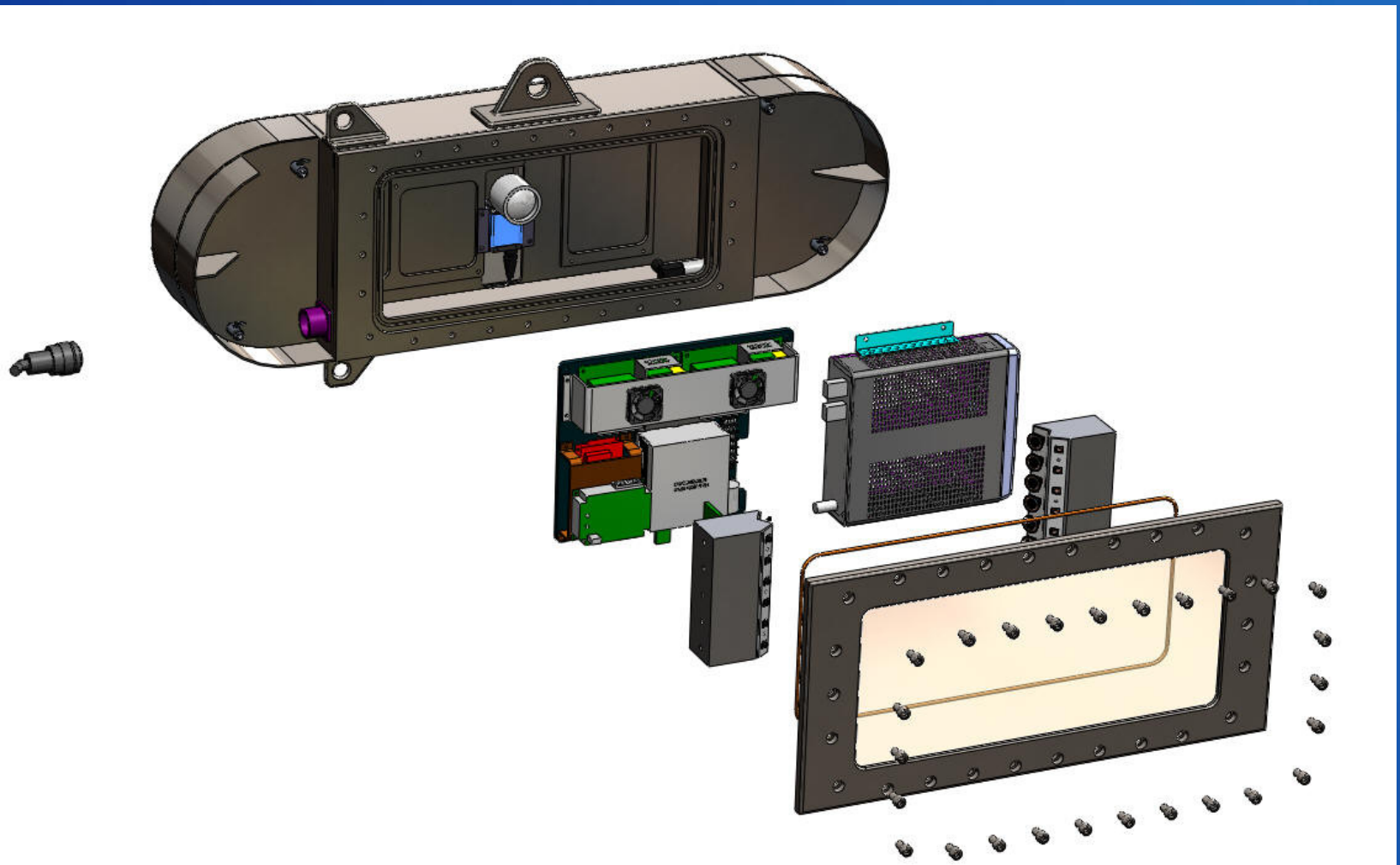

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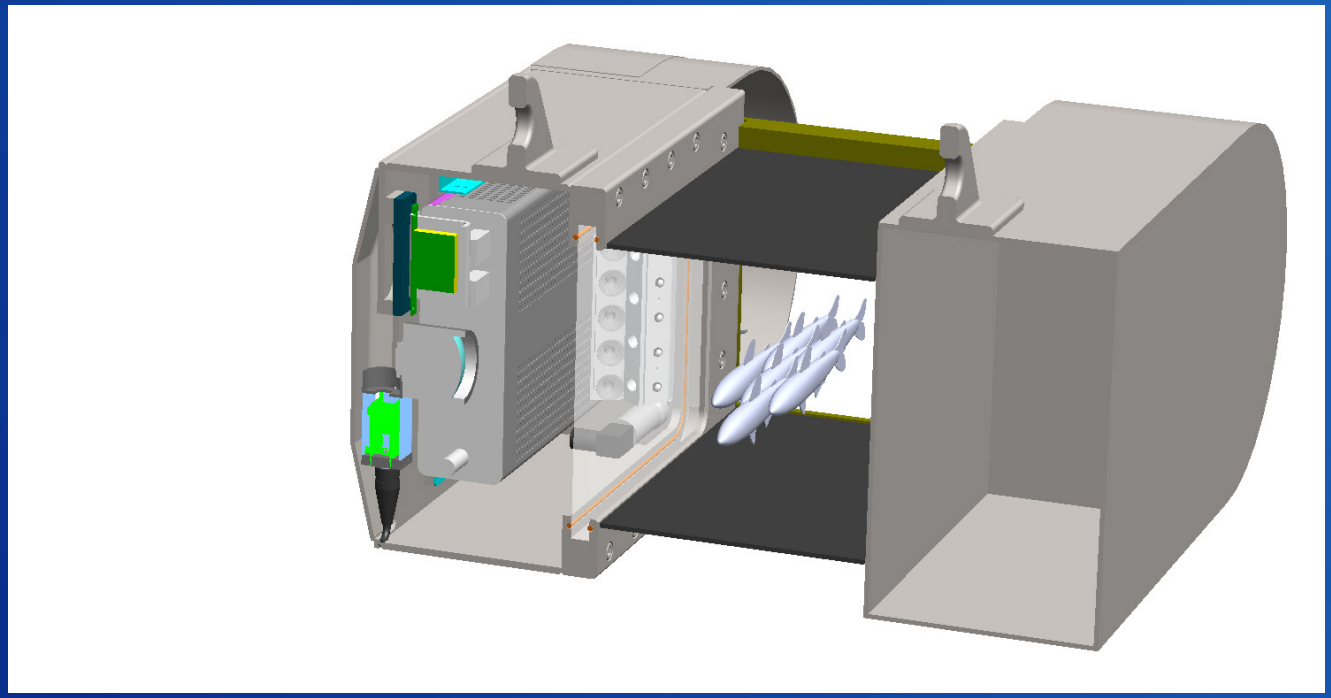

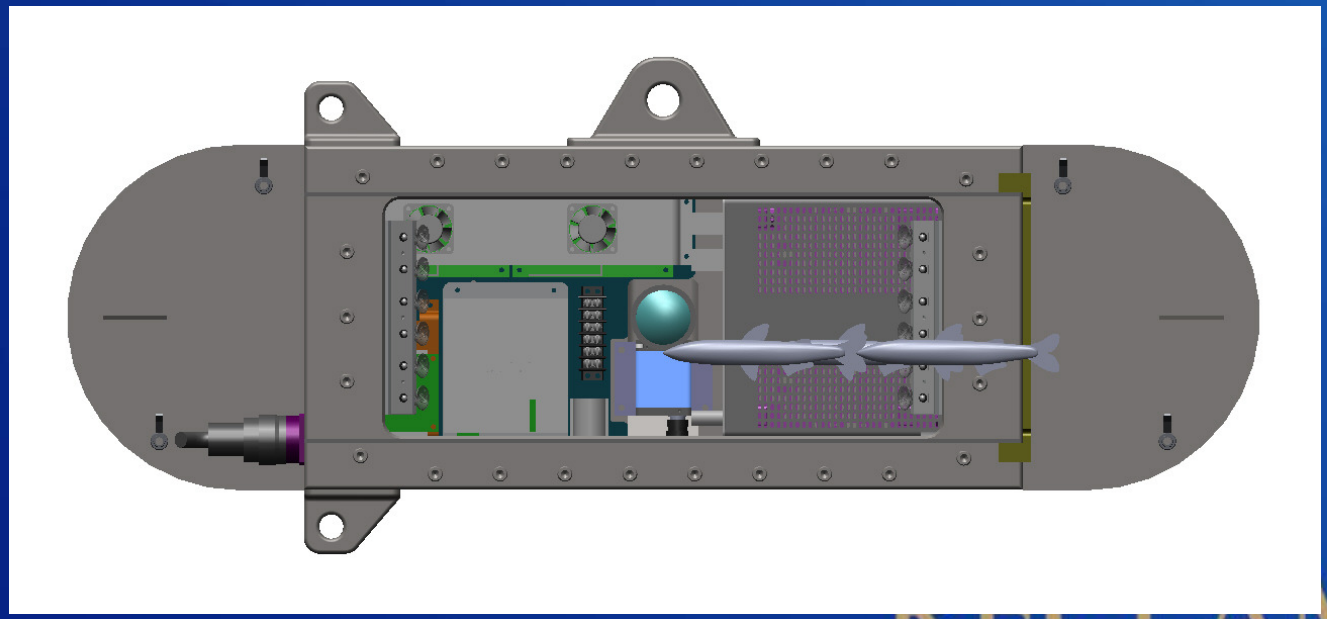

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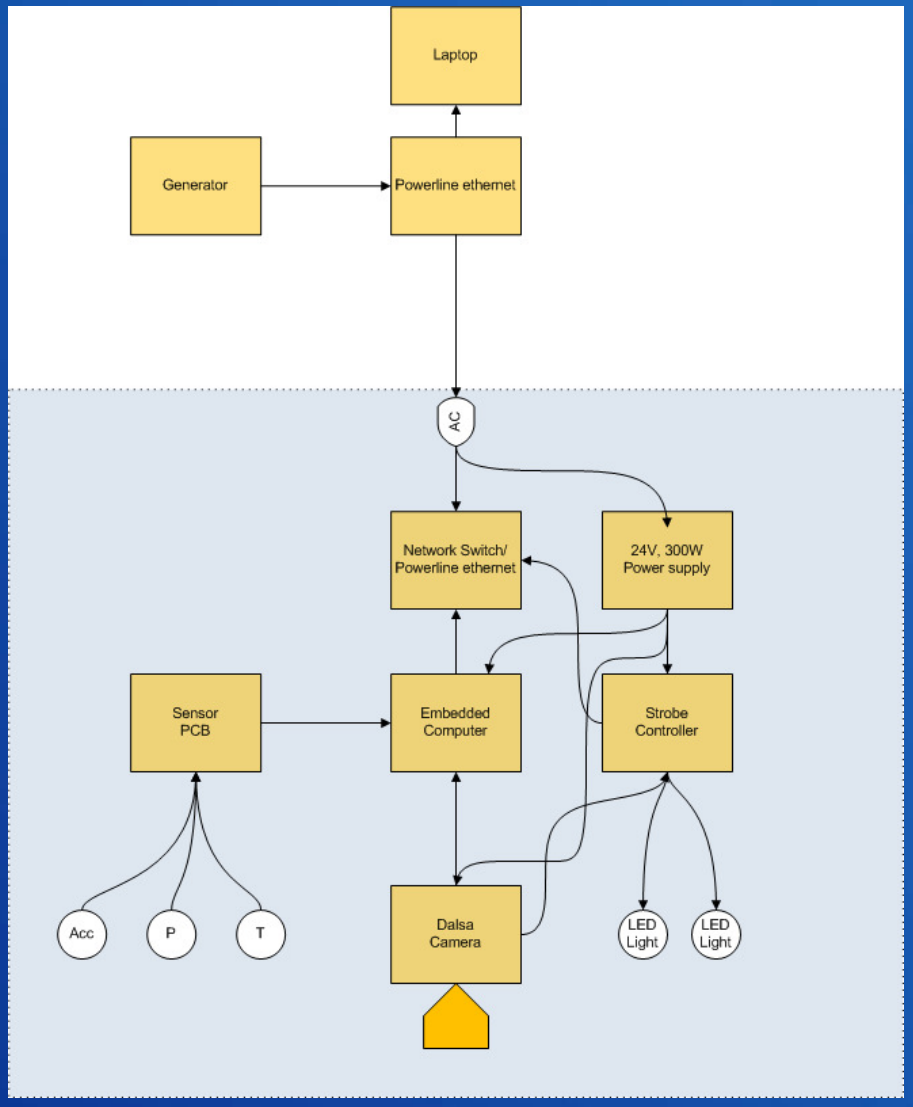
Electrical Design

- ✓ Embedded computer does tracking and image queuing.
- ✓ Laptop does high-level classification.
- ✓ Single flexible cable on slip-ring reel



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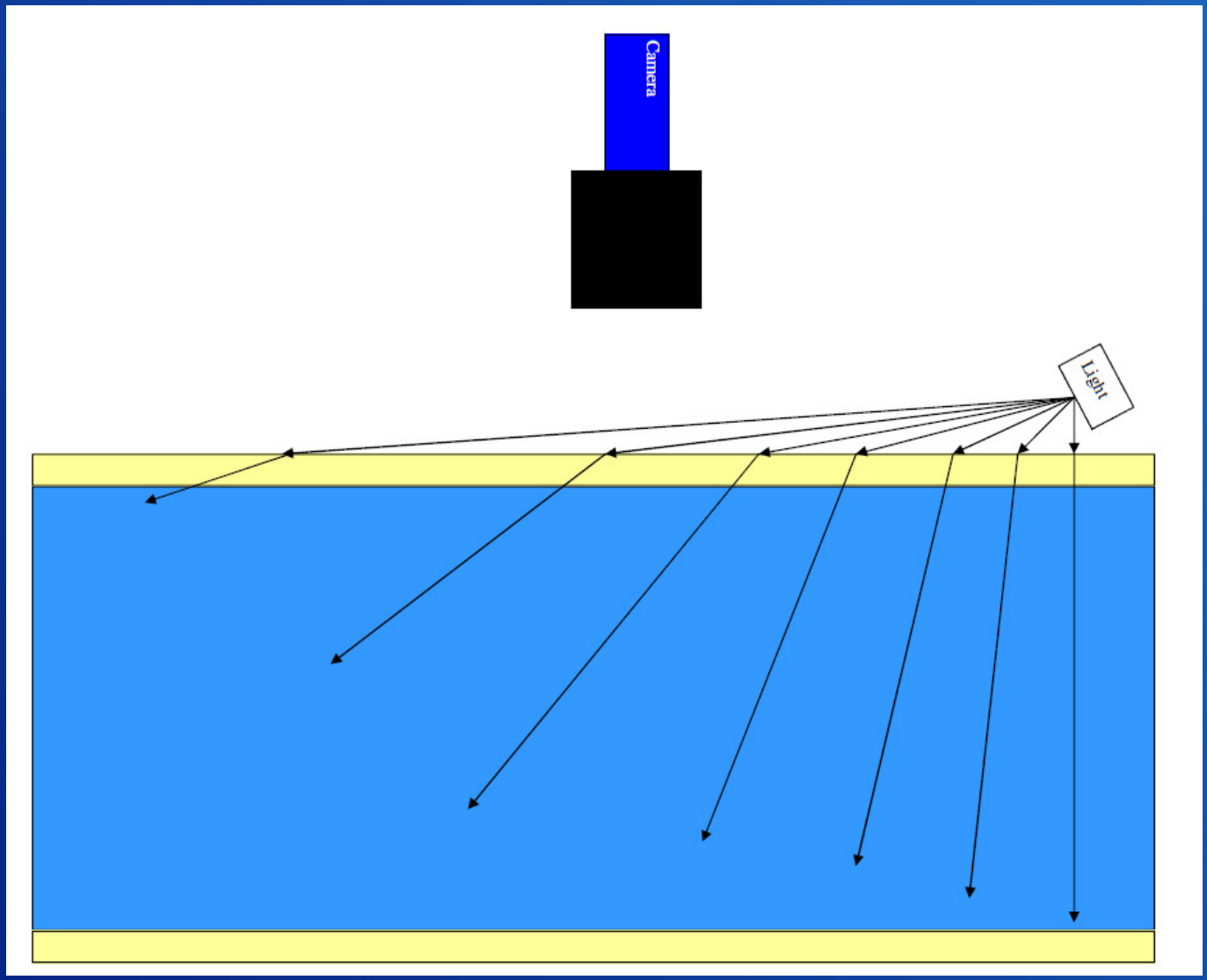
Lighting Challenges

- ✓ Lessons learned:
  - ✓ Lighting placed near camera causes reflections on acrylic and unnecessary image noise.
  - ✓ Strobe LEDs in sync with camera to reduce power and freeze moving objects better.
  - ✓ Much of white light gets absorbed by water, use blue where camera is most sensitive.
  - ✓ Wide angle of disparity reduces turbidity (backscattering).

Lighting testing



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Software Algorithms

- ✓ Tracking
- ✓Fish / non-fish detection:
- ✓Fish classification
- ✓User interface

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Software Algorithms-Tracking

- ✓Tracking consists of:
  - ✓Foreground segmentation
  - ✓Image preparation
  - ✓Blob detection
  - ✓Object size filter
  - ✓Object trajectory filter

Software Algorithms- Tracking

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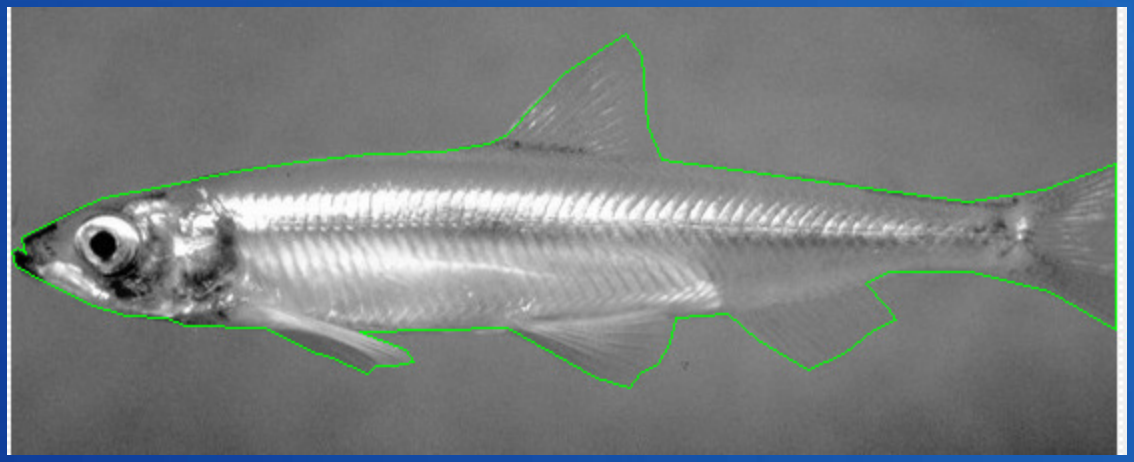
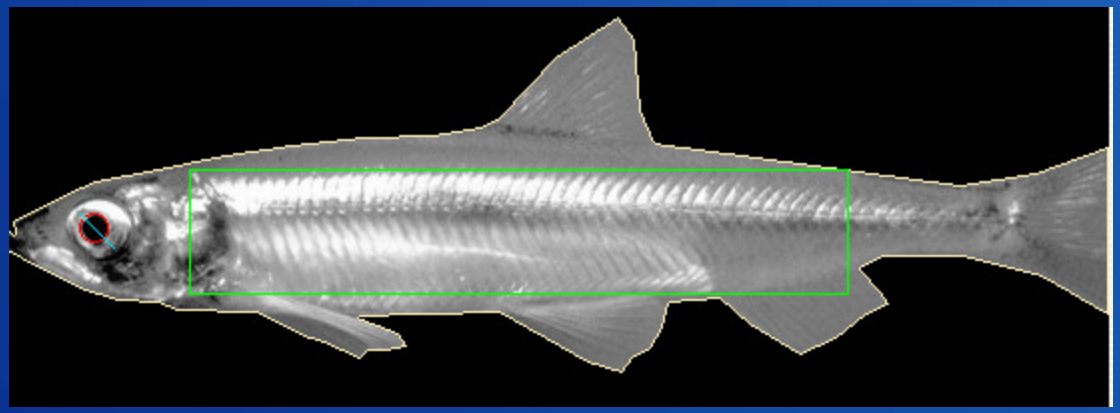
Software Algorithms
Fish / non-fish detector

✓Shape classifier



✓Eye & side view detector:



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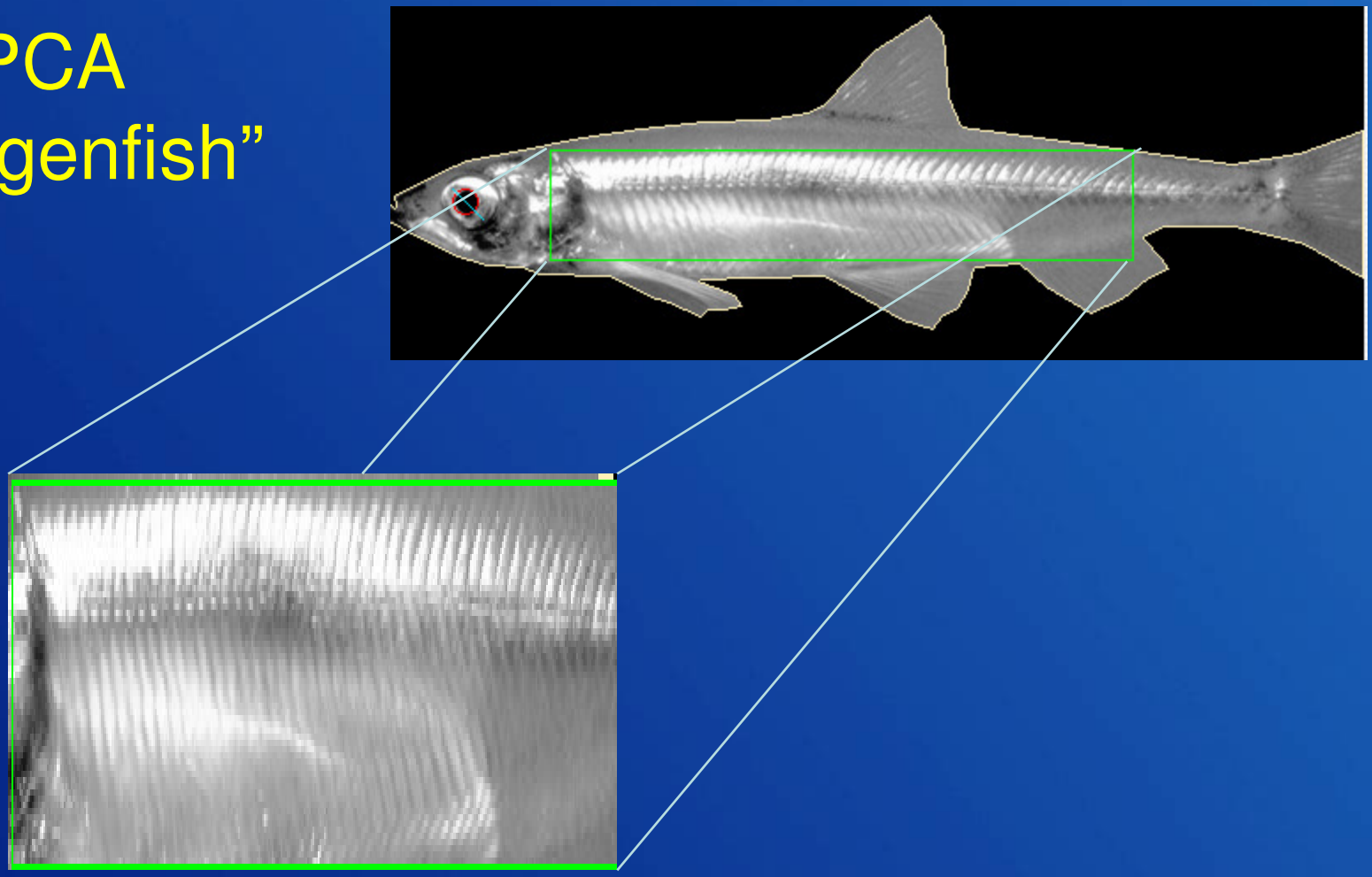
Software Algorithms
Fish classification

✓PCA
"eigenfish"



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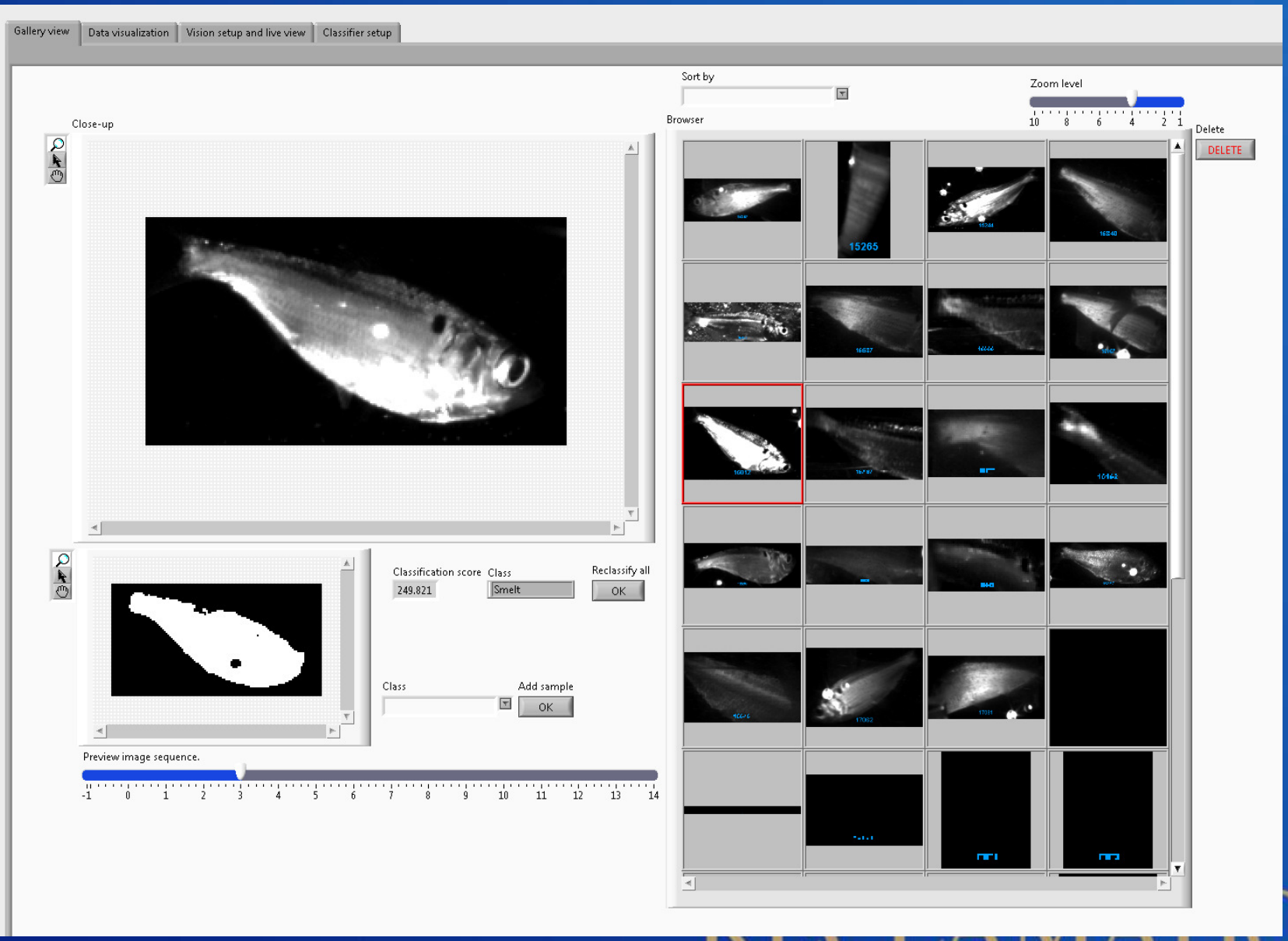
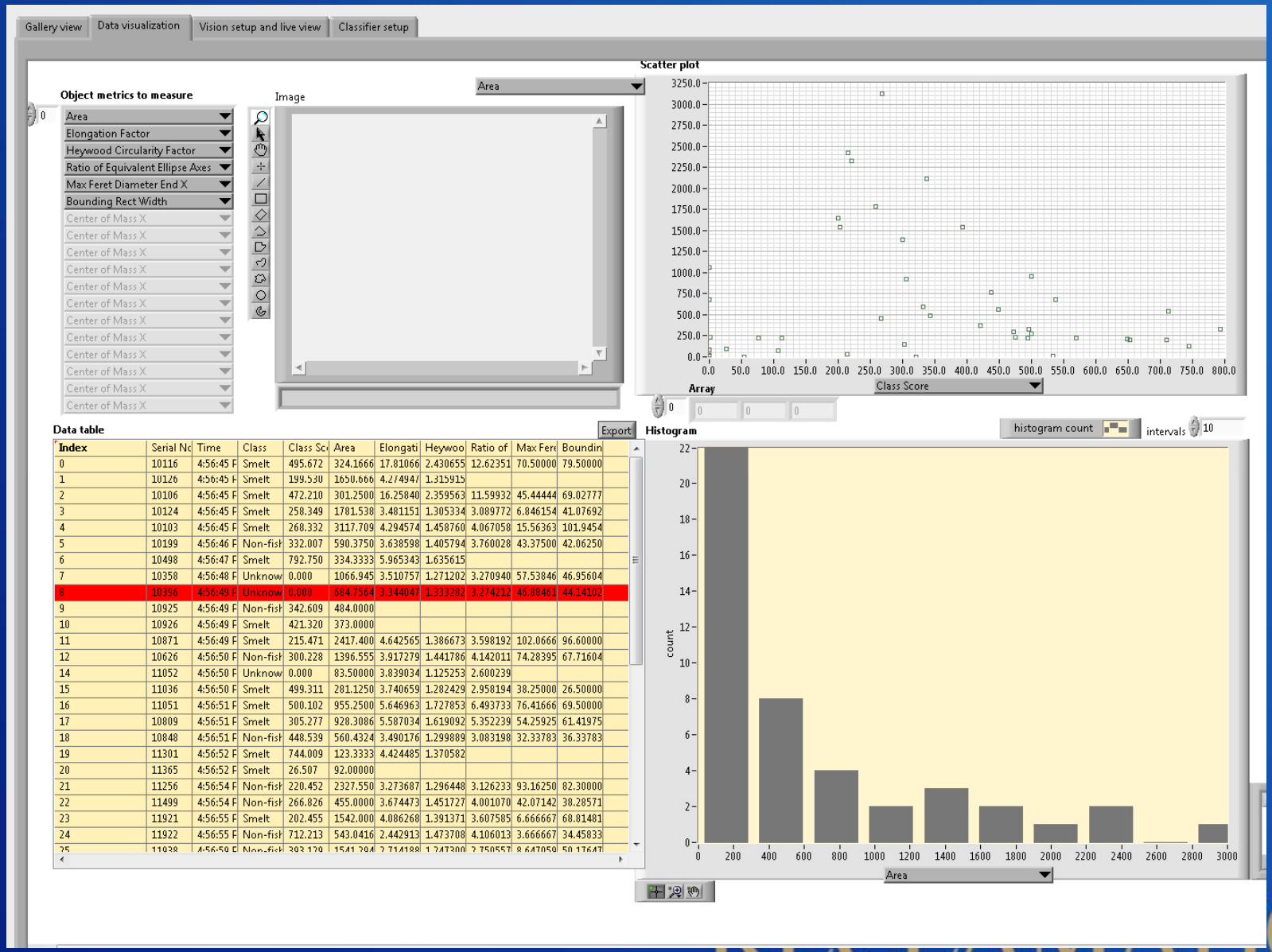
Software: User Interface

- ✓Goals
  - ✓Intuitive, responsive view of real-time data
  - ✓Rapid training and classification.
  - ✓Post processing, sorting, and data analysis

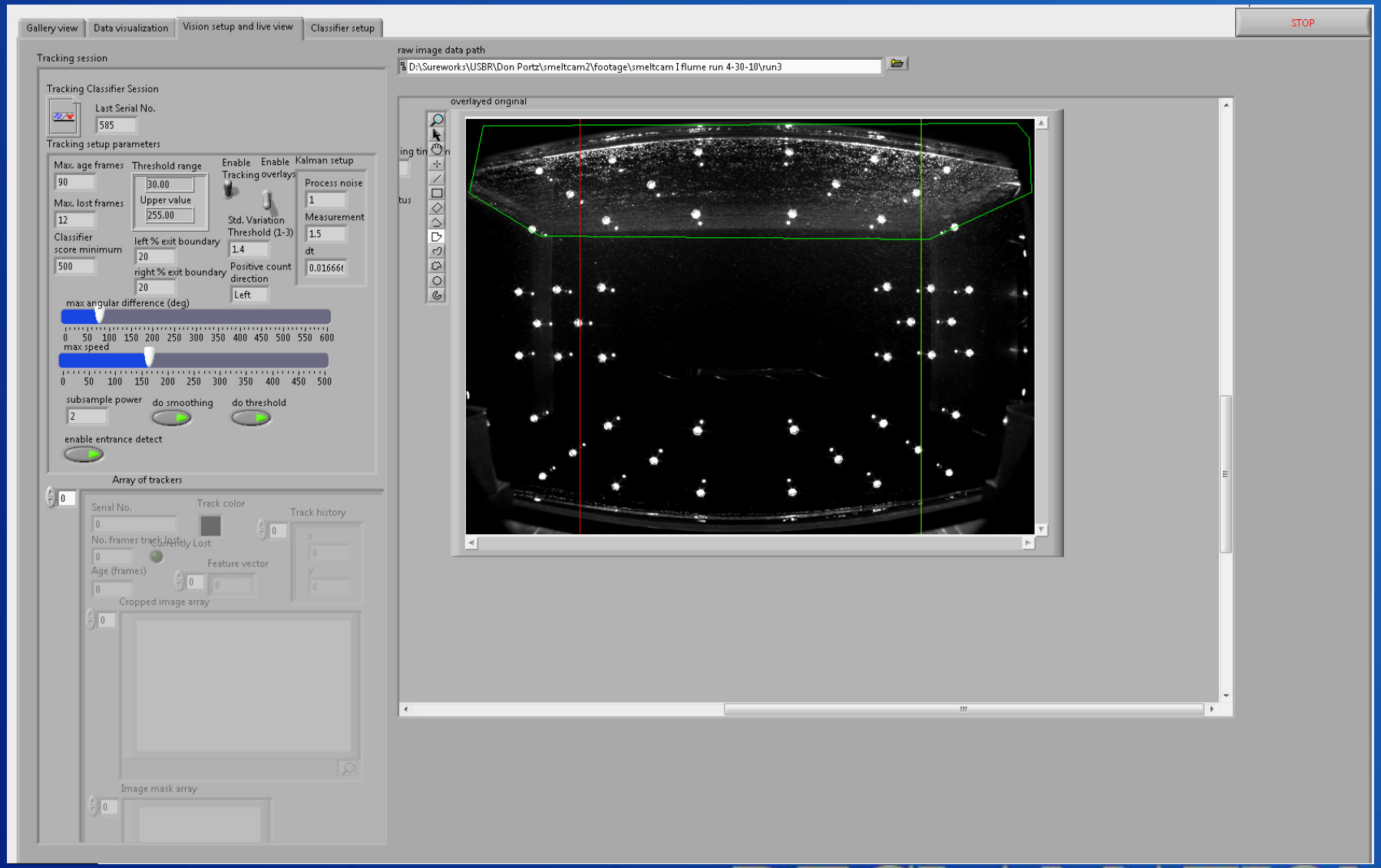
Software: User Interface



Software: User Interface



Software: User Interface



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Future Enhancements

- ✓Software
  - ✓Improved object recognition database
- ✓Physical
  - ✓Open frame ‘rover’ design with less wasted air space and less weight.
  - ✓Custom electronics
    - ✓DSP based tracking and compression routines
    - ✓Custom lighting and power

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