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Bivalve Larvae Identification System (BLIS)

This *in situ* instrument consists of a polarized light, high speed strobed imaging system with a full wave compensation plate to produce species-specific birefringent color patterns in larval shells (Gallager and Tiwari, 2008). Flow enters a continuous flow cell where an acoustic ultra-sound generator produces a focusing effect of the larvae and particulates with an 10:1 concentration into a stream directly at the focal point of the 10X objective lens. The machine vision camera captures full frame images and the embedded processor find Regions Of Interest (ROIs) that are in-focus targets above background contracts levels. The ROIs are organized by time or size and may be displayed in real-time on a web interfaced GIU. Training sets may be produced with images of known hatchery-reared larvae. A Deep Learning Model is constructed and trained on as many training species as possible- this process is lengthy and requires up to a day to complete on the embedded processor and GPUs. Once trained the model may be run in real-time on the embedded processor to identify larvae as they are acquired as ROIs. Results are displayed as the number of a given species per unit time (concentration) and by size frequency histograms of each species.

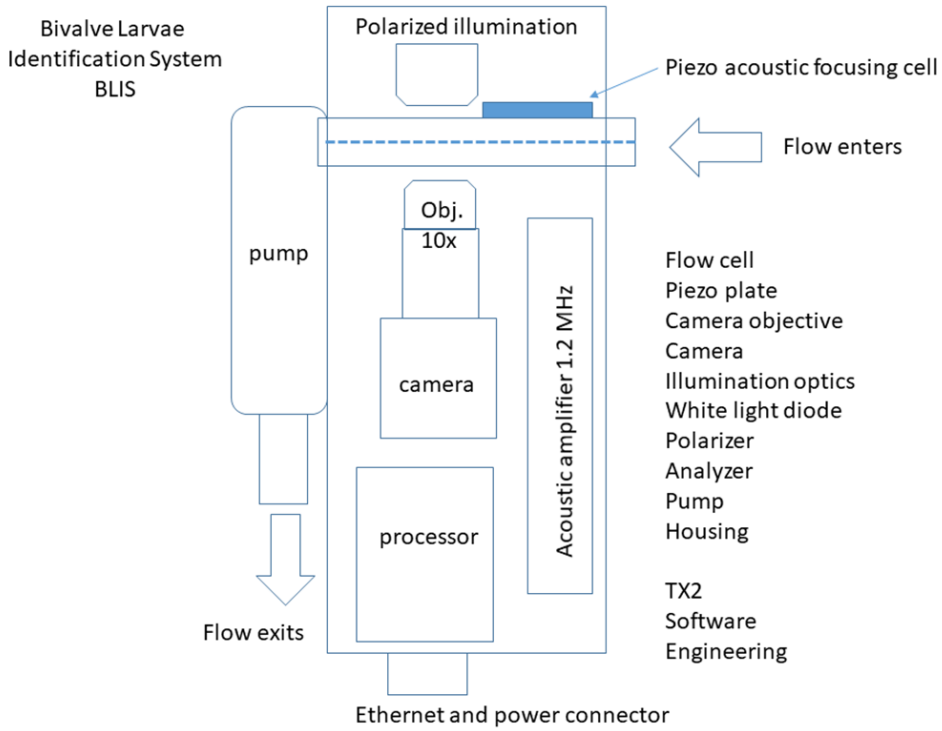
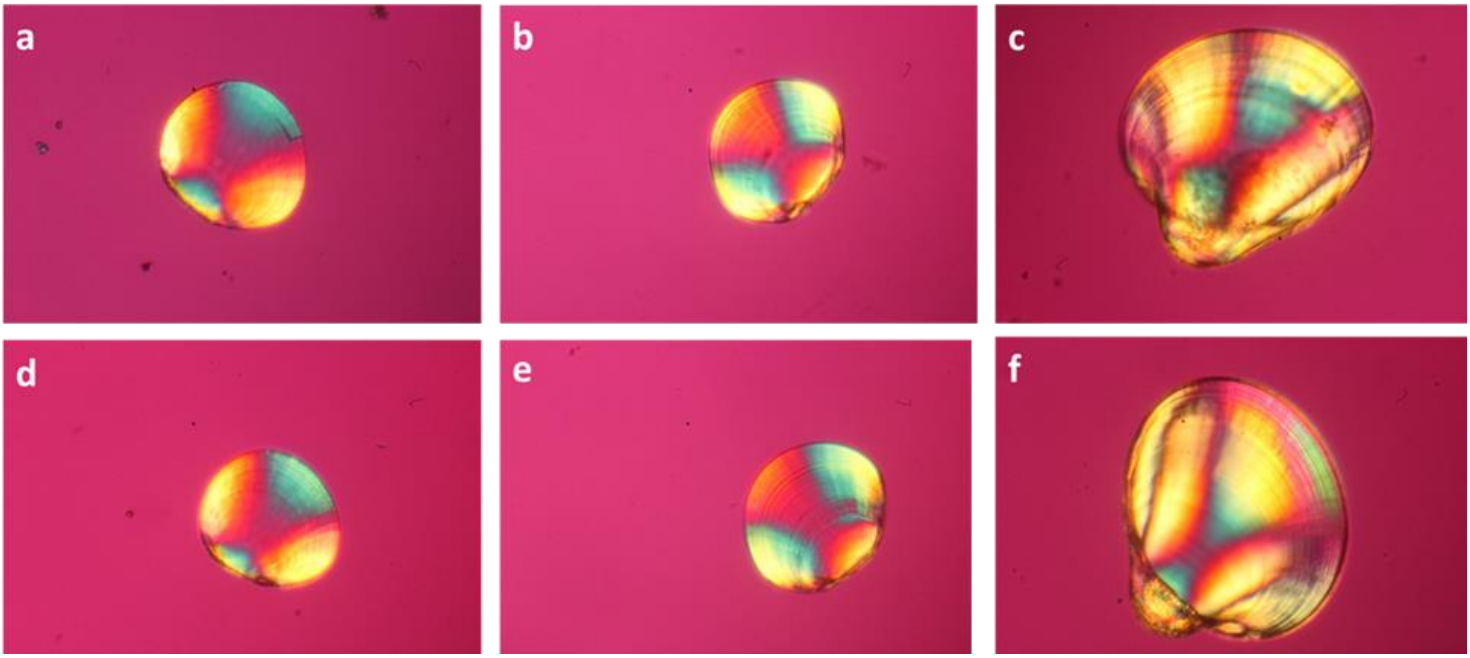
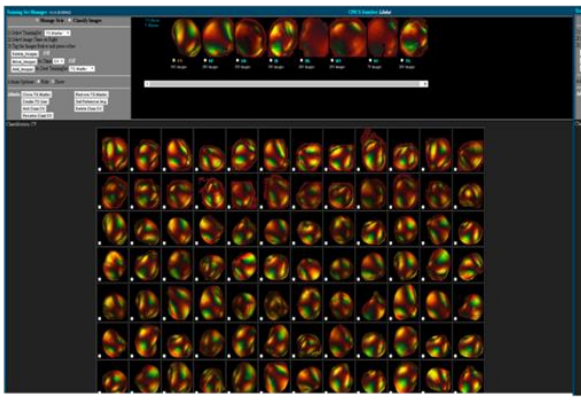


Diagram of the BLIS instrument inside a pressure housing for in situ deployment. Communications is by Ethernet and an external CTD such as the SeaBird SBE 37 may be connected to an 8-pin port to record Temperature, Pressure and Salinity along with each ROI.

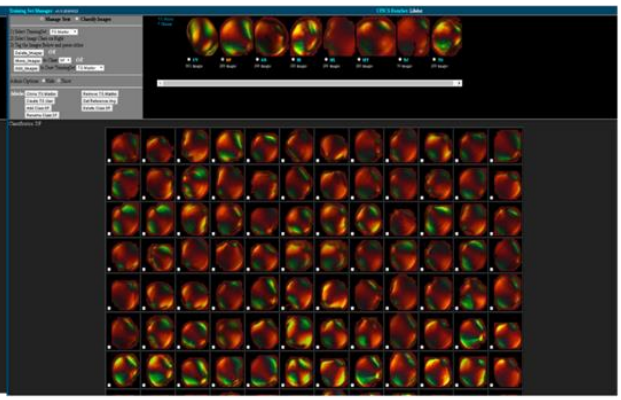


Polarized light images a) Argopecten irradians; b) Mercenaria mercenaria, and c) Crassostrea virginica from our collection from 2005 compared with images of the same species on the lower panels (d,e,f) reared more recently showing that larval age in archive does not interfere with birefringence pattern.

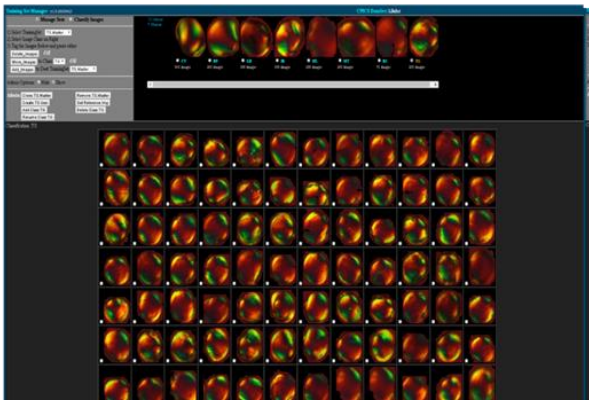
Crassostrea virginica



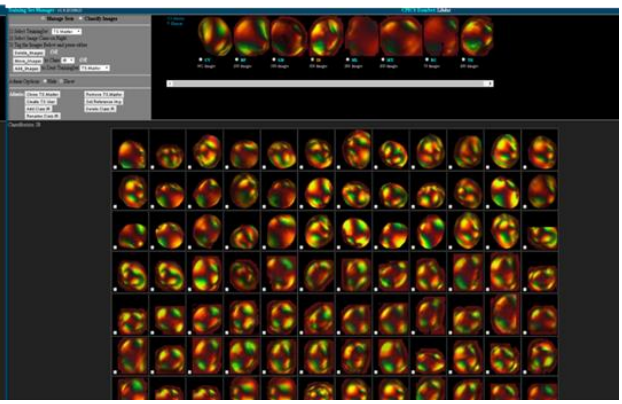
Mytilopsis leucophaeata



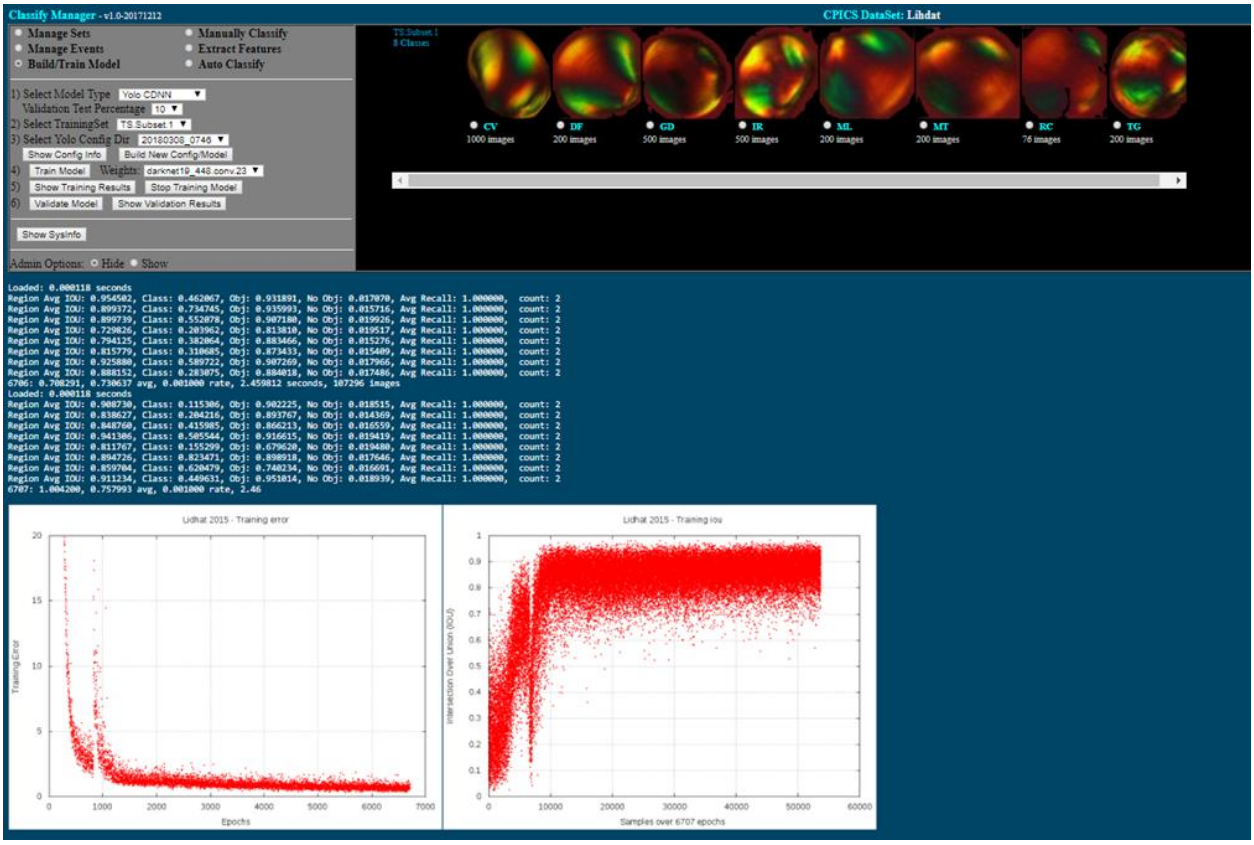
Tagelus plebeius



Ischadium recurvum

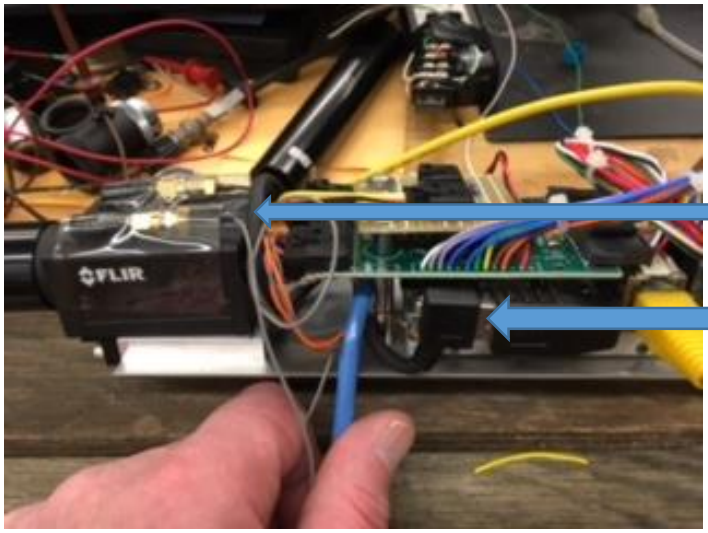


Training sets for four species of bivalve larvae located on the ShellBi server in Gallager's lab. Functions on the top left allow set manipulation, renaming, and other tools and actions. ShelBi is the software package that is responsible for classifying bivalve larvae to species and making morphological measurements on the shells.



Example of the ShellBi Deep Learning classification model being built and coming to convergence after 20 hours of running time. Eight species of larvae were used in this training exercise.

The BLIS instrument open and on the bench. Once inside the housing the instrument is rated to a depth of 10 m. Extended depths possible.



References

Gallager, S., and S. Tiwari. 2008. Optical method and system for rapid identification of multiple refractive index materials using multiscale texture and color invariants. United States Patent 7,415,136. Washington, DC: U.S.