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One Fish, Two Fish: Choosing Optimal Edge Topologies for Real-Time Autonomous Fish Surveys

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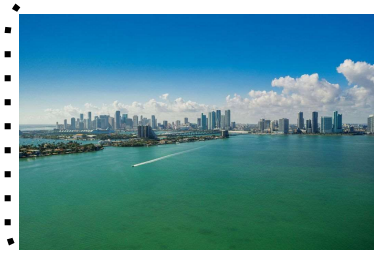
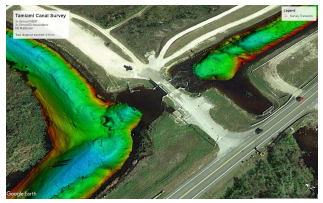
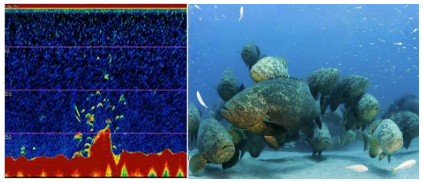
Research Use Case

Coastal marine ecosystems under pressure



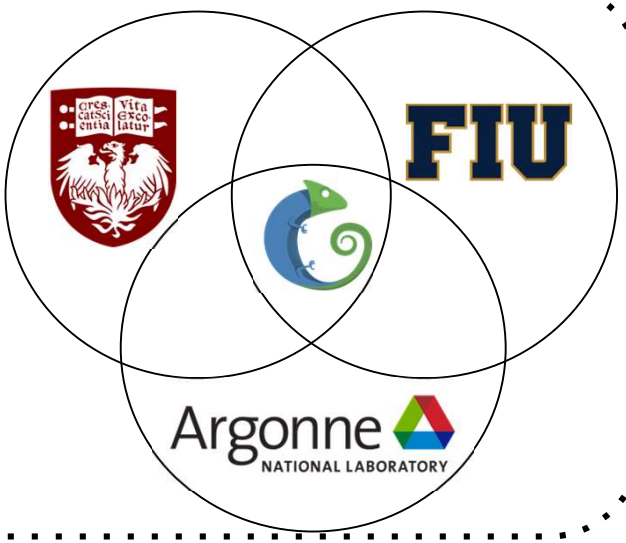
Evaluating impacts in coastal systems is challenging and costly





Autonomous vehicles are non-invasive platforms to acquire high resolution data in dynamic ecosystems

A partnership was formed to find solutions to this problem



Research Use Case

- Can autonomous vehicles (AVs) be adapted to efficiently survey coastal domains and collect data to describe ecosystem status?
- What is the best strategy for collecting and analyzing data from AVs: on-board or in the cloud?
- Does the presence and quality of the network determine data handling/processing strategy?
- In this work we compare configurations in which the vehicle is equipped with an intelligent edge device versus configurations that perform similar computations in the cloud.

Testbed requirements

Working at a distance presents its challenges however with the possibility of operating with Chameleon Cloud, many of these barriers are overcame or facilitated which are:

- Convenience of choosing between *bare metal* from CHI@Edge, CHI@UC and CHI@TACC
- Easy access to change source codes through Chameleon Cloud that connects directly CHI@Edge to the autonomous vehicles.
- Having access to powerful GPUs allows me to train and improvise my Artificial Intelligence model more efficiently.
- Chameleon has several security systems that allow me to have reliable remote access.

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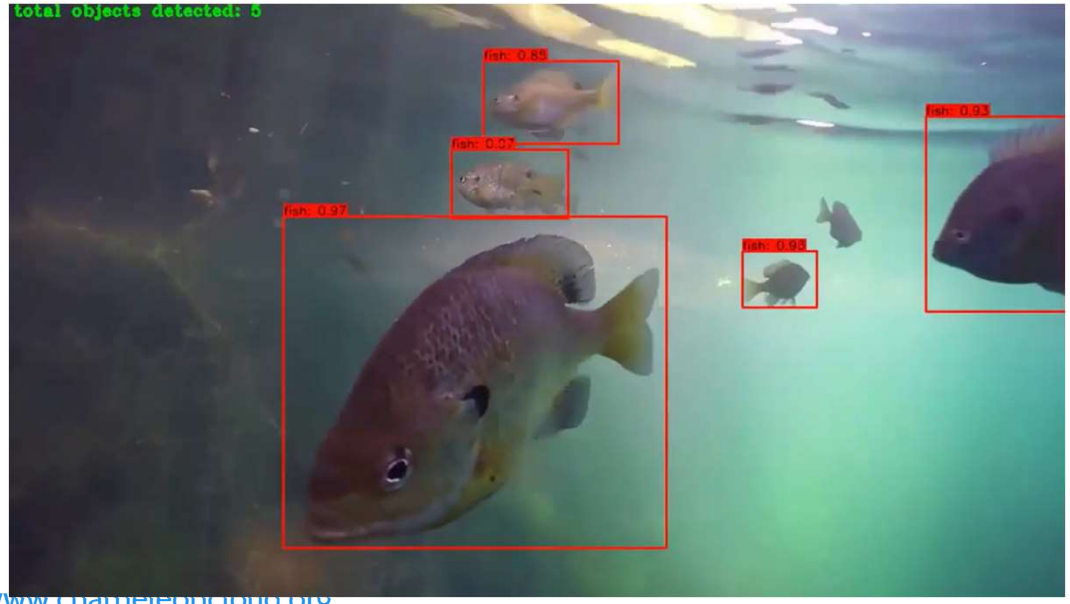
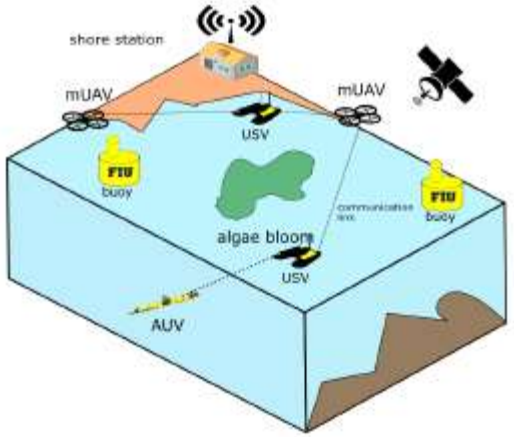
CHI-Edge value

- For this experiment we ran the model on a dataset of 10,000 images all with the same size (336 kb) and after running the algorithm we collected the median and standard deviation of the dataset.
- Below is an example of the result obtained by the algorithm



CHI-Edge value



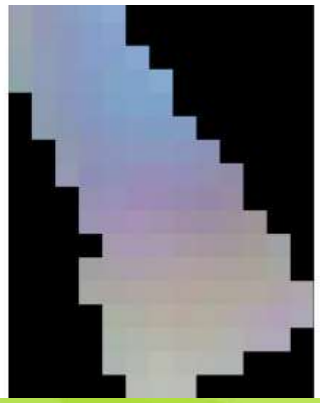
- Edge/Cloud Computing will be central as we deploy heterogeneous teams of autonomous vehicles for environmental monitoring.
- The computational and storage needs of important tasks will exceed the capabilities of our devices (due to size, cost, and energy constraints).
- OpenStack with bare metal reconfiguration
- Reconfigurability (bare metal), isolation, network reconfiguration, power on and off, reboot, custom kernel, serial console access, and the Jupyter Notebook integration
- Having Chameleon as partners is great, some features still in development

Future Uses I: Sensing

What new/additional features do you envision and with what priority? C5

- We will continue our work in computer vision and DL: Fish tracking, coral reef, data from tags, geometric information, data from animal tags.
- We want to explore other sensing modalities such as LIDAR, Acoustic, Hyperspectral
- Remote Sensing: Huge storage requirements




Slide 7

C5 1. Environmental awarness: both physical awarnes (lidar or similar) and AI awarness (classification of images and desitions based on that: if it is a kayak, slow dow, if it is a jetsky, stop and avoid, if it is a pelican, don't bother).
2. Netwroked mapping: networked devices, like ASVs, buoys, and satelite images, collaborate to crate an intelligent, dynamic, sampling strategy. They can slect points of intrest, areas of risk, obstacles on the ASVs paths or changing weather condtions.
Camilo, 9/8/2021

Future Uses 2: Models and Planning

What new/additional features do you envision and with what priority?

- Oceanic, Hydrodynamics, Diffusion Models (CFD, Inverse Methods, PDE in general).
- Autonomous Vehicles Planning (POMDP, Deep Reinforcement Learning)