**Eng’g projects for SIO students:**

**Nuno Bandeira**

**Computer Science and Engineering**

**Project title**: Computational mass spectrometry analysis of marine and other natural products.

The GNPS resource (<http://gnps.ucsd.edu>) for community-scale computational mass spectrometry analysis of marine (and other) natural products has many samples from SIO labs and a summer project is available for a student to work with us and the SIO labs over the summer to help annotate the samples metadata and use these to analyze the possible functional implications of the many marine compounds detected in the hundreds of mass spectrometry runs from SIO labs.

**SIO projects for eng’g students:**

**Lynn Russell**

**Project title:** Solar-Powered Aerosol Particle Sampling for the Pismo Beach Dunes.

This project will design, assemble and test a system for solar-powered aerosol particle sampling at the Pismo Beach dunes forremote, long-term operation.  The system will be used to identify particle composition and sources during high wind episodes at the dunes. The project will require engineering design of structure and power requirements, close coordination with state park authorities, and preparation and maintenance of documentation, tools, and spare parts.

**Kim Prather**

**Project title**: CAICE wave flume

A project for an engineering student is available at the wave flume at SIO as part of the Center for Aerosol Impacts on Chemistry of the Environment (CAICE) (<http://caice.ucsd.edu>). This will include designing and building new instruments.

**Sarah Giddings,** **Lisa Levin** and **Jeff Crooks**

**Project title:** Oyster Shell Biosensors

**Project Description:** Our lab is currently developing biosensors to measure an oyster's shell gape (how far open it is) and its heartbeat. Oysters with biosensors will be deployed in local estuaries next to physical oceanographic instruments measuring the water conditions (temperature, currents, dissolved oxygen) to assess oyster response to the environmental conditions. An undergraduate student will help with sensor development and sensor testing (both in the field and in laboratory tanks). Involves work at the Tijuana River Natural Estuarine Research Reserve.

**Either Eng’g or SIO students:**

There are a couple opportunities for either Eng’g or SIO UGs to be involved in **Engineers for Exploration** (E4E):

**Project title**: E4E Coral Reef Surveying.

Engineers for Exploration ([http://e4e.ucsd.edu](http://e4e.ucsd.edu/)) is working with the SIO Coral Reef Ecology group (<https://scripps.ucsd.edu/labs/sandin/>) to build a tool to streamline the metadata collection process in creating these 3D models.  Currently, divers need to record depth and heading at the corners of the edges of the survey plot, which is a somewhat error prone process.  We are building a tool which uses a depth sensor and compass to accurately record and filter these data, and presents the results on LEDs for divers to read and capture as part of the survey process.  By embedding the data within images, we can use computer vision techniques to read the data and associate it with the images in the model without requiring human intervention. This will enable our collaborators to scale their data collection efforts without scaling the overhead in model generation, letting them focus on the science.

**Project title:** Automated Mangrove Classification Using High Resolution, Multispectral Aerial Imagery.

Despite their small height and occupying a relatively limited area, mangroves play an important role in the overall ecosystem along the desert coasts of Baja California. Along with their role in fisheries production and coastal protection, mangroves produce organic sediments of significantly high importance to global carbon sequestration and carbon storage. These ecosystems are incredibly productive: one hectare of coastal mangrove forest in the Gulf of California provides services worth up to $100,000. Unfortunately, mangroves are little understood and highly undervalued. This lack of awareness has led to global losses of over 35% in the last three decades. Documenting mangrove habitats is difficult due to their accessibility, density of foliage, and coverage. Yet it is vital for ecologists and conservationists to catalog the distribution, variety, and diversity of these ecosystems. Traditional mangrove studies are laborious and require “boots on the ground” to perform visual identification of species and measure above and below ground biomass. Such studies remain important, but are not scalable enough to provide a larger understanding of mangrove ecosystems. We have a unique opportunity to augment and enhance the data collection on mangrove environments using unmanned aerial vehicles (UAVs). UAVs provide orders of magnitude higher fidelity data than satellites: 1-100 cm2 pixel resolution vs. 1-100 m2 pixel resolution. This project is a collaboration between the Aburto Lab (<http://aburtolab.ucsd.edu/>), Kastner Research Group (<http://kastner.ucsd.edu/>), and Engineers for Exploration (<http://e4e.ucsd.edu/>).

**Project title:** Soft robots for exploring inside coral reefs.

Coral reefs are declining worldwide. With the impeding threat of climate change related stressors, such as ocean acidification and ocean warming, coral reefs are likely to continue to along this path. Although known threats to coral reefs are already taking hold, critical information about the basic biological, ecological, and chemical processes that sustain coral reefs remain unknown, because researchers are limited to studying only the surfaces of coral reefs. Yet coral reefs are massive, three-dimensional structures with many tunnels and crevices spread throughout, which have never before been rigorously explored. The majority of the species living within the coral reef matrix and the properties of their unique environment remain unknown to science, simply because this it is exceedingly difficult to access internal structures of reefs.  This project is developing a soft robot that uses a pressurized, compliant membrane that unrolls at the tip to penetrate deep into the coral reef matrix to answer critical questions in coral reef ecology with soft robotics. This effort is cross-disciplinary collaboration between the groups of UC San Diego professors Tolley (MAE), Kastner (CSE), and Sandin (SIO), and Dr. deVries at UC Davis.  Goals for the summer will be to refine an existing prototype design for testing underwater in aquaria with simulated reefs, with the goal of developing a system that can be deployed in the ocean.

**Project title:** Crab inspired hard/soft robots

Crabs are widely successful animals that live in all the oceans of the world, in fresh water, and on land. With over 7,000 described species, crabs have evolved a broad suite of morphological adaptations to occupy diverse habitats and niches. Key among these adaptations is the rigid shell that protects crabs from many insults and enables them to apply large forces to walk, run, and crush their prey. However, their rigid shells limit their growth. To overcome this challenge, crabs exhibit a unique approach of shedding their shells in a process called molting, during which they temporarily switch from a rigid exoskeleton support system to a soft hydrostatic support system. During the subsequent period prior to the hardening of their new shells, the soft-shell crabs inflate their bodies to increase their size, and operate in the world as soft-bodied animals. While most animals use only one or the other of these supports systems throughout their lifetime, crabs repeatedly switch between the two. Inspired by this amazing hybrid hard/soft support mechanism in crabs, as well as their broad success in a wide variety of extreme habitats, this project aims to develop a class of crab-inspired robots capable of switching between rigid and soft, inflated support structures. These hybrid hard/soft robots will have significant advantages over both traditional rigid robots and also existing soft robot designs. This project is a collaboration between the groups of Prof. Tolley in MAE and Prof. Taylor at SIO. Summer students will work with graduate students from both groups to work on projects related to the development of crab inspired hard/soft robots.