

## Research Summary of Graduate Student of Hoque-Lab: Denson Smith



Figure 1: Denson Smith

My research focus is using machine learning to detect seamounts (Figure 2). Seamounts are active or extinct undersea volcanoes that rise from a few hundred feet to thousands of feet above the seafloor. The highest seamount is Mauna Kea in Hawaii. Mauna Kea is an extinct volcano that rises from 18,000 feet beneath the ocean surface to over 13,000 feet above the ocean surface. This base-to-peak height of over 30,000 feet is more than twice Mount Everest's base-to-peak height of 15,000 feet. It is estimated that there are at least 100,000 seamounts that rise at least 1000 feet above the seafloor. Many seamounts have not yet been detected or mapped.

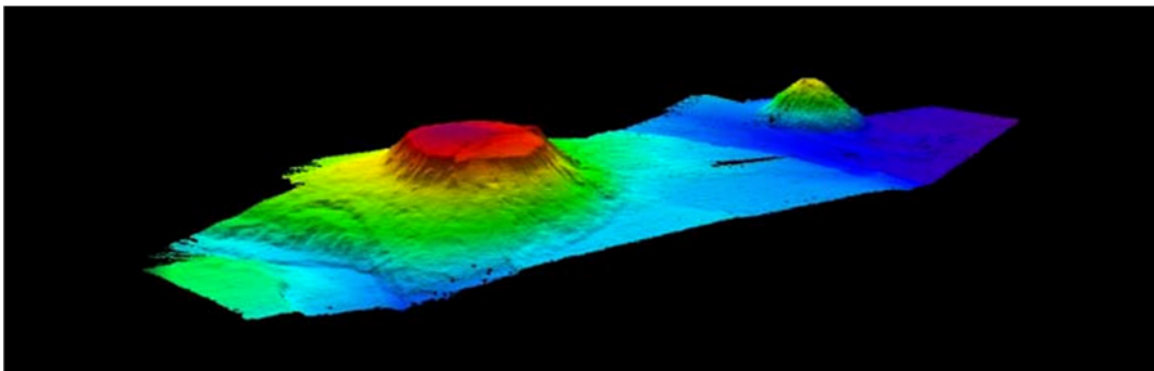


Figure 1: Bear Seamount with Physalia Seamount in the background

Machine learning is a branch of artificial intelligence that provides computers with the ability to learn without being explicitly programmed. A good example of machine learning is the face detection (Figure 3) on your smartphone's camera application. Detecting seamounts (Figure 4) is mathematically similar to detecting faces, no two are the same but they all have some features in common. The challenge is to determine which features all seamounts have in common.

Detecting seamounts is important for many reasons.

- Seamounts represent a hazard to navigation, especially for submarines. The USS San Francisco, a US nuclear attack submarine struck an unmapped seamount in 2005 while traveling at over 40 mph. One sailor was killed and many more injured. The damage to the submarine was over \$500 million.

- Large seamounts can collapse and cause tsunamis. If the location of a large seamount is known, it can be monitored to give warning to people in areas likely to be affected by a tsunami.
- Seamounts support diverse ecosystems including many commercial fishing species.
- Seamounts are a potential source for mining rare minerals and ores.
- Seamounts affect undersea currents and mixing of ocean waters.
- Seamounts help scientists understand other processes that form the Earth's surface.

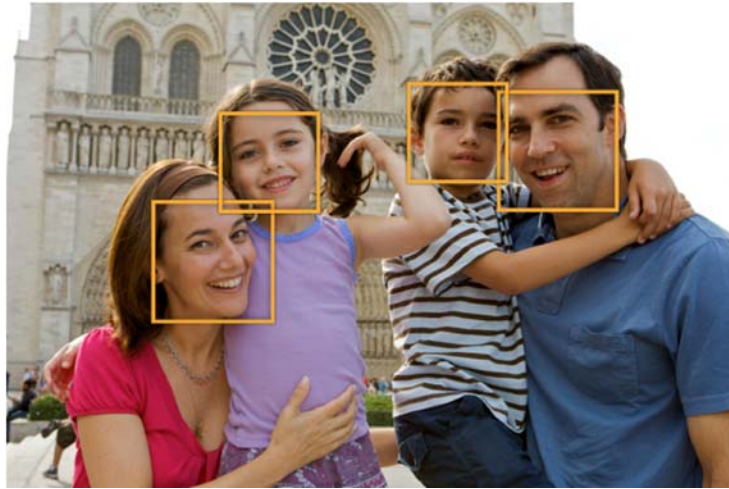


Figure 2: Face detection on a smartphone.

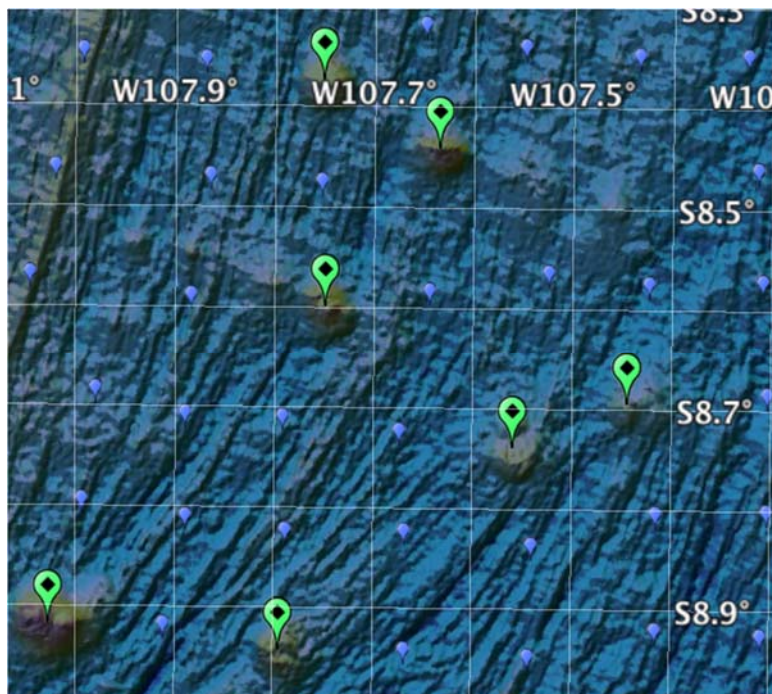


Figure 3: Seamounts detected by my software.