Deven Maheshwari

The icy cold, green-tinted waters of the Atlantic Ocean are home to marvelous seals that are currently the subject of Navy research. Animal migration has long taught humans about how different species cope with environmental changes and can be used as warnings for when ecological disasters may be occurring. Seals are no exception. Currently, GPS technology is being used to track these animals through the use of the Argos satellites that can obtain information about the seals whether they are underwater or on land. However, this tracking does face problems as water blocks radio waves, which makes satellite communication difficult unless the path to the seal from the satellite is clear.

This issue opens up a variety of new solutions and possibilities for gathering data. One of which is the use of alternative modes of tracking: particularly the use of synthetic aperture radar (SAR) or inverse synthetic aperture radar (ISAR) to image larger migration areas. According to the book Radar Imaging for Maritime Observation, the use of these two techniques can help in tracking animals and environmental phenomena as they can explore larger areas using aerial photographs and signals. Where SAR creates its viewing area through the use of a traveling radar, ISAR focuses on a single subject which creates a more full view. Both of these methods can be used in conjunction to create specific geographical and population mappings. Not to mention that a simple object detection program can aid in the seal classification once enough experimental data is established. An artificial intelligence module such as this can be trained by a human and continue to be improved through increased amounts of imaging. These two approaches are also unaffected by weather and have significantly better results than traditional optical imaging, proving their reliability and potential value to Naval research. Although imaging through water can be difficult, SAR and ISAR imaging has proven their effectiveness in shallow waters, which is helpful because seals tend to stay on coastal shores.

Aamir Qaiyumi from the “Autonomy for Unmanned Systems” video is someone who inspired me through his passion for robotics and his changing career goals. He originally wanted to be an astronaut, but through his education, Qaiyumi was able to work with devices that are necessary for both his field and in space. His versatility shows the large capabilities that technology has as unmanned vehicles are being used in similar fashions from submarines deep underwater to rovers. Qaiyumi has also done work in educating younger generations about engineering and autonomous vehicles and has taken part in RobotX challenges and presentations to improve the technology of autonomous systems. His commitment to educating others through his videos and presentations has helped me understand the need to have both technological innovation and effective communication skills. A combination of these can make the use and development of technology easier as they develop credibility in new innovations by decreasing the intimidation someone may feel when entering this complex territory.

Qaiyumi also inspires me because his work with autonomous systems is related to my interest in artificial intelligence. AI is a rapidly growing field that focuses on deep learning algorithms that learn with more data and autonomous systems can rely on this mechanism to have dependable decision making. AI is also another technological facet that can be applied to many different fields due to its data modeling capabilities as long as the user has knowledge of other fields to implement AI in. I hope to work with AI as it relates to environmental engineering as there is a growing need in the renewable

energy field and as I have learned, there is also a great benefit in tracking animal migrations and survival tactics. All three of these applications will help humans live in a sustainable environment by reducing carbon emissions and conserving natural resources, while simultaneously mitigating the threat of natural disasters.

Twenty years from now, technology will continue to revolutionize society at an alarming rate according to Moore's Law. By 2040, the devices used today will be able to do so much more than humans can imagine right now. One field that will undoubtedly advance is robotics. The traditional view of robots is one of bulky, slow-moving objects with a highly limited range of motion. But in April 2020, engineers from the University of California San Diego developed a new type of robot, contrary to the restricted ones already designed. In an effort to create more flexible robots with a strong foundation, these engineers have used 3-D printing and modeled them after insects, creating "flexoskeletons." The benefit of having these sorts of materials in robots is that they are small enough to enter small areas and are still durable. The production is also cheap and simplified compared to previous robots. These flexoskeletons are based on a polycarbonate sheet with a layer of polymers that uses other more rigid parts to strengthen the mold. Each part costs less than $1 and under 10 minutes to produce, however it can take two hours to fully construct one of these robots. Some researchers even find that these soft-bodied flexoskeletons can have some of their parts be replaced with LEGO-like parts to make repair and construction easier.

The goal of making these robots was to create more, smaller robots, with the ability to do more work than conventional ones that are larger and whose parts can be easily replaceable. The current assembly needs humans to facilitate it, but the goal is to have an automated assembly line to construct them. The usage of these robots is unclear as their movement is being studied and stronger and more flexible alternatives to polycarbonate are being looked at, but a group of them have the ability to do as much work as one large robot. In terms of work, possible applications could be search and rescue teams of flexoskeletons instead of human ones and is a start to creating more advanced bio-based robots. Because they are also based on models of animals, it can give insight into the biology of these creatures and how their limbs function effectively. These robots still have their drawbacks, particularly in the length of time they can be doing work and new shapes are still being considered.

In regards to studying the migration patterns of seals, these flexoskeletons could be modeled after seals and be placed in controlled environments to study seals more effectively. Developments in autonomous underwater vehicles can help in allowing the robotic seal to interact appropriately with its environment and can help remediate the issue of tracking as the Argos satellites can only track the seal tags in certain circumstances. Animal-based robots as a whole can give new insights into the daily lives of seals and can serve as human-controlled sensors of environmental changes in areas that are usually inaccessible. For the Navy, bio-inspired underwater animals can be less environmentally damaging than traditional ships when studying wildlife. They can also serve as a safety precaution instead of sending humans to potentially dangerous locations to observe the seals. Already created flexoskeletons already

have high hopes to be working in space and if they have the potential to do that, they certainly have the potential to be used underwater in Naval studies.