Rokos Award

Robotic Charging and Wind Circularity at BP - Janina Branke

Humanity is currently facing its biggest challenge yet: climate change. Our sustainable energy sources, electric vehicle infrastructure and logistics must be improved to reduce the damage being done on our planet. I'm extremely grateful that the Rokos Award enabled me to make progress in the renewable energy space through my internship at BP. The projects I contributed to included the development of a robotic arm for electric vehicle charging and determining methods to improve the circularity of offshore windfarms.

Robotic Arm for EV Charging

Currently, the number of electric vehicles is on an unprecedented upward trend so new charging stations are in high demand. I worked in collaboration with the Technical University Graz, on developing their prototype for a robotic arm that can be used in EV charging. Once complete, the robotic arm will detect the vehicle, its charging port and its lid opening mechanism. Using the information, the robotic arm will open the lid and plug in the cable.

The robotic arm is a complex system, requiring many hardware and software iterations. However, it is just as important to ensure the robot's acceptance and safety, as it is to ensure the functionality of the system. A demonstration of this robotic arm can be seen at https://youtu.be/QlJiWI92Jso.

The purpose of the robotic arm is to improve accessibility of charging by reducing the user involvement and streamlining the process. Today, about 22% of the UK population has accessibility needs, which new technologies need to accommodate for. Lowered mobility and wheelchair usage can create barriers in the use of traditional EV charging stations because fast chargers run at very high voltages and are water-cooled, making them very heavy and difficult to manoeuvre.

To investigate the suitability of the robotic arm for accessibility and usability, I commissioned research to find out the public's pain points and therefore locate areas of improvement. Once complete, this research will assist in the further development of the robotic arm. Another potential future use case of the robot is for charging autonomous fleet hubs without the need for human input or to enable more efficient future car sharing by charging autonomous vehicles while they are not in use. Using autonomous vehicles in this capacity would be more environmentally friendly as it would require a smaller total number of cars.

To model the robotic arm's kinematics and response to forces such as gravity and friction, the team and I used Nvidia Isaac Sim. This improved my understanding of simulations and allowed us to test many different configurations with respect to the car and the arm with minimal cost. Another focus area was the sensor placement and types of sensors that would be most suitable. The current design has a camera attached to the arm and future iterations could include pressure sensors in various places to reduce the risk of crashing into the car or a nearby person. We also considered the use of x-rays to determine the interior design of the charging port prior to opening the cap, as the inside cap on electric vehicles are not standardised and need different manoeuvres to be opened.

Windfarm Circularity

Due to my interest in offshore wind energy, I attended a national offshore conference where professionals presented on their technological progress and visions. At this event, I also joined update sessions from offshore start-ups which are being funded by BP and helped evaluate the start-up's potential and progress to ensure that they receive enough financial support. These experiences were a lot of fun and gave me a better understanding of the industrial progress in the offshore space. I then decided to to participate in a research project myself, focusing on new methods to improve current and future windfarms.

One way to extend the lifecycle of a wind turbine is by using predictive maintenance, implementing finite element analysis to identify the stresses within the structure at locations that cannot be measured directly. I decided to concentrate on creating a centralised database for the data gathered at BP's various offshore wind sites and use this for the identification of future windfarms sites as well as for improving maintenance. Evaluating this database can be streamlined and sped up using quantum computing. This idea showed a lot of merit and is currently being pursued further by the BP quantum team in Huston.

Moving Forward

Overall, my time as a technology innovation engineer has been an invaluable experience and has provided me with a lot of knowledge about simulation, project planning and research. I am very thankful for the Rokos Award and I hope to continue working in the renewable energy space as it is a vitally important area of development. The internship also allowed me to meet inspiring people in the industry and learn about many current offshore start-ups. Moreover, the offshore wind project has strengthened my expertise on data processing and will give guidance for my upcoming master's project, which is focused on virtual sensing of offshore wind structures through field monitoring.