



### **IET Travel Award Report 2022**

After more than two years of the COVID-19 pandemic, I am finally confident to travel abroad for collaboration visit and conference. The IET Travel Award for International Travel is a proud award for young researcher like me to make travel to other countries for social engagement and networking as well as sharing our research outcome with other great researchers. I am very honored and thankful to IET for the award to support my trip to Singapore in October 2022. I am also very grateful to the IET panels and liaison officer, Mdm. Jennifer Tilley for rearranging a new schedule for me due to vaccination restriction in Germany. My official trip to Singapore from 25 October to 28 October is a fruitful one with a collaboration research visits to University of Glasgow Singapore (UofG) – Singapore Institute of Technology (SIT) and IEEE Conference for Communications and Smart Grids 2022. The IEEE Conference for Communications and Smart Grids is a prestigious international conference which aims to provide a forum for researchers and practitioners from academia, industry, government institutions, and regulators in the area of communications, energy, control, and signal information systems analytic and processing related to smart grids. Out of all activities in the conference, the best session is the testbed tour visit. We were toured in a group to different testbed such as 5G wireless testbed, power-grid testbed, and drone testbed. Besides, I have also attended the tutorials by technical specialists, ie “IOT-Based Load-Altering Attacks Against Power Grids” by Prof. Subhash Lakshminarayana from University of Warwick and “Using Global Wireless Standard-Based Networks to Modernize the Communication Infrastructure Used by Grid Operators” by Mr. Larry J. Horner from Intel USA. I am grateful for a small discussion session to address to the current situation on renewable energy batteries lifespan issue with my topic on “Lifetime Predictive Model Using Rain-flow Algorithm for Small-scaled Solar Powered Batteries Farm” with experts & practitioners and also researchers from University of Glasgow Singapore. In this modern world, energy plays an essential role in the economic growth of a country. According to statistics, power consumption will increase at rate of around 1.5% annually and 6% annually for the developing countries, such

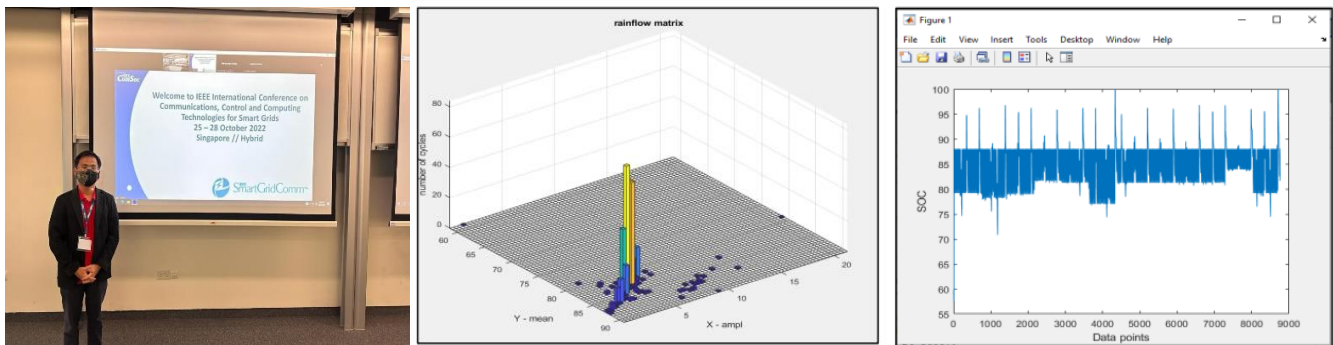
as Malaysia. [1] Renewable energy is believed to be the best alternative solution compared to traditional energy types. Though the future of solar power systems is quite promising, it still has some liabilities such as battery ageing which impacts maintenance cost. Batteries are essential components of solar power systems storing excess power generated, so it is crucial to predict its lifetime accurately. I have demonstrated a suitable method to determine lead acids batteries' ageing and eventually their lifetime. This technique relies on the rain-flow counting algorithm which counts the cycles of the batteries' state of charge (SOC). Using the SOC data obtained, the battery depletion rate is then evaluated thereby making it conceivable to make inferences about the battery life expectancy. The method used perfectly with MATLAB toolbox. Results from the rain-flow counting algorithm demonstrate the impact of the SOC cycles' amplitudes and range on lead acid battery degradation rate. A mean of six years of life expectancy is recognized for most evaluated sites in my research. I am fortunate to have connected myself with researchers from University of Glasgow Singapore Campus. The team from University of Glasgow Singapore, led by Assoc. Prof. Dr. Sye Loong together with his colleagues, namely Dr. Lawrence Seow, Dr. Henrik Hesse, and Dr. Peter Yau has welcomed me to the university and we have discussed interesting topics on our respective research interest, such as 5G wireless connectivity, smart cities, drones' applications, and antenna propagation. A tour visit around the university was guided by Assoc. Prof. Dr. Sye Loong and a lunch gathering was organized at one of the great restaurants in the university. At the end of the visit, we have identified potential projects and grants applications to kickstart by next year. These are valuable outcomes from our discussion and hopefully, we are able work together in the upcoming projects too. A visit to main attractions in Singapore was organized by conference mate, Dr. Tay Fei Siang and Mr. Ong Chin Ann on day 3 and thankfully, we have visited several places, such as Sentosa Island, Marina Bay, Orchard Road, and Bugis Street. My visit to the Singapore for the aforementioned activities has granted my project significant publicity within my network and has led to various conversations and discussion with various partners in Singapore. I would like to sincerely thank the IET for granting me this great opportunity. Without the IET's support, it would have been difficult for me to attend and most importantly, my research output would not have gained publicity and collaboration. This is certainly one of my best memories in life, thanks to the IET Travel Award 2022.

1. M. Hadwan and A. Alkholidi, "Solar power energy solutions for Yemeni rural villages and desert communities", Renewable and Sustainable Energy Reviews, vol. 57, pp. 838-849,

### **Snapshots of all memorable moments between 25 and 28 October 2022**



*Picture 1: Selfie with Singapore Jewel Airport View as background; Picture 2: Conference venue at Singapore University of Technology and Design (SUTD); Picture 3: Testbed lab visit tour; Picture 4: Future Communications Lab*



*Picture 1: Research sharing at the venue; Picture 2: Rain-flow counting algorithm slides on my site measurements; Picture 3: State of Charge (SOC) explanation for solar batteries*

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