Numerical and Analytical Model Development for Tidal Barrage Energy Output

Menart, Peter

The main purpose of this project is to further improve the models available for calculating the energy output of tidal barrages. This project will build on the previous year's project, which developed an analytical equation for two-way tidal barrage energy generation. As far as is known, this is the only such equation that exists. To prove that this model is correct, a numerical model has been developed in this year's project. This numerical model accounts for variable release rates, variable surface areas, and variable turbine efficiencies, whereas the two-way analytical model only allows for constant values of these quantities. The numerical model was programmed in Python and the results were compared to those from a published paper that used a very sophisticated numerical method based on the Navier-Stokes equations to calculate energy output. The comparisons indicate that the numerical model is quite accurate, with a maximum error of 8%. Since the numerical model proved to be accurate, it was used to check the two-way analytical model, and both yielded exactly the same results. To further verify the analytical method, a one-way analytical model was developed and compared to the published Navier-Stokes equation results. The results were within 26% the published results, which is a decent comparison given that the analytical model does not account for varying parameters. Lastly, a survey was done to determine the benefits of two-way generation, which showed that two-way generation provides a much longer energy generation period than one-way, as well as more energy.

Awards Won:

Fourth Award of $500