Data-driven stochastic modelling of power-grid frequency applied to islands

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Mitigating climate change requires a transition away from fossil fuels towards renewable energy. As a result, power generation becomes more volatile and options for microgrids and islanded power-grid operation are being broadly discussed. Therefore, studying the power grids of physical islands, as a model for islanded microgrids, is of particular interest when it comes to enhancing our understanding of power-grid stability [1, 2]. In the present work, we investigate the statistical properties of the power-grid frequency of three island systems: Iceland, Ireland, and the Balearic Islands using two different approaches. First, we utilise a Fokker–Planck approach to construct stochastic differential equations that describe market activities, control, and noise acting on power-grid dynamics. In particular, we propose stochastic power-grid frequency models and showcase the applicability of these new models to non-Gaussian statistics, as encountered in islands [3,4]. Second, we apply physical-inspired machine learning (PIML) to power-grid frequency data [5]. Specifically, we exploit techno-economic features to determine model parameters using neural networks. Thereby, we obtain physics-inspired trajectory forecasts for the power grid frequency in islands.

References

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