Load Profile Inpainting for Missing Load Data Restoration and Baseline Estimation

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This paper introduces a Generative Adversarial Nets (GAN) based, Load Profile Inpainting Network (Load-PIN) for restoring missing load data segments and estimating the baseline for a demand response event. The inputs are time series load data before and after the inpainting period together with explanatory variables (e.g., weather data). We propose a Generator structure consisting of a coarse network and a fine-tuning network. The coarse network provides an initial estimation of the data segment in the inpainting period. The fine-tuning network consists of self-attention blocks and gated convolution layers for adjusting the initial estimations. Loss functions are specially designed for the fine-tuning and the discriminator networks to enhance both the point-to-point accuracy and realism of the results. We test the Load-PIN on three real-world data sets for two applications: patching missing data and deriving baselines of conservation voltage reduction (CVR) events. We benchmark the performance of Load-PIN with five existing deep-learning methods. Our simulation results show that, compared with the state-of-the-art methods, Load-PIN can handle varying-length missing data events and achieve 15-30\% accuracy improvement.