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**Residential Household Non-Intrusive Load Monitoring via Graph-Based Multi-Label Semi-Supervised Learning**

**Abstract**

Non-intrusive load monitoring refers to inferring what appliances are operating in a household at a given time solely from fluctuations on the main power feeder. It is one approach to demand-side management strategies in the Smart Grid, and most current research employs machine learning to make those inferences. However, the learning algorithms used usually require knowledge of the set of appliances active at each sample instant, in addition to the main feeder fluctuations. This data is not ordinarily available in field usage. As a compromise, we examine semi-supervised learning algorithms, which only need a small sample of observed power signals annotated with active appliances (e.g from an initial “registration" period). As multiple independent appliances may operate concurrently, we furthermore employ multi-label classification in our solution. Three new graph-based semi-supervised multi-label load monitoring algorithms are proposed, and evaluated on five public datasets. We find that the best algorithm can outperform state-of-the-art results on these datasets.