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Complexity of Power Draws for Load Disaggregation

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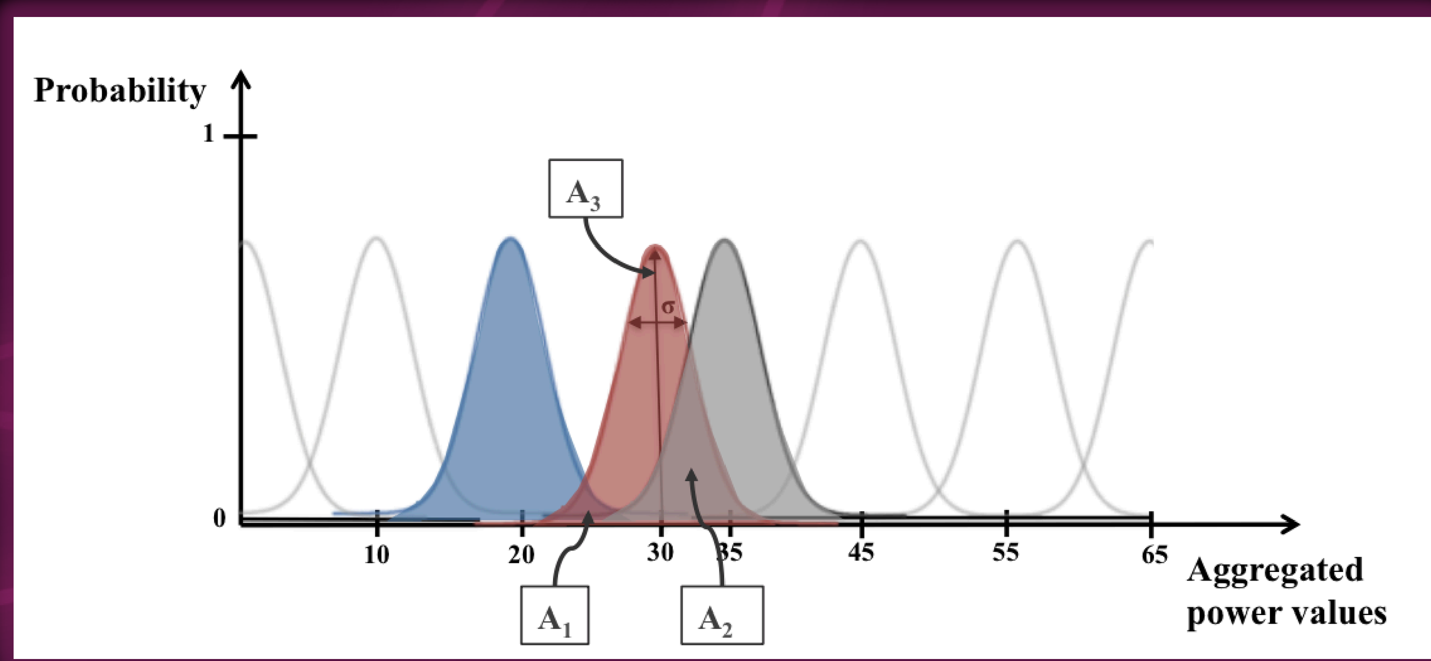
Load disaggregation algorithms try to break down the aggregated power draw of an energy system to the appliance components. The performance of these algorithms is usually measured with test power draws, however the particular power levels and usages of devices have a large influence on the success rate. In this work, we introduce two novel complexity measures to assess the complexity of a load disaggregation problem based on the used appliance sets.

One important aspect is the distinction between the disaggregation approach itself and the problem of aggregated power profiles. Beside clear performance measures for NILM algorithms it needs a clear definition to specify the hardness or complexity of a specific case. This makes a fair comparison of different NILM approaches with respect to the used load disaggregation problem possible.

Appliance Set Complexity

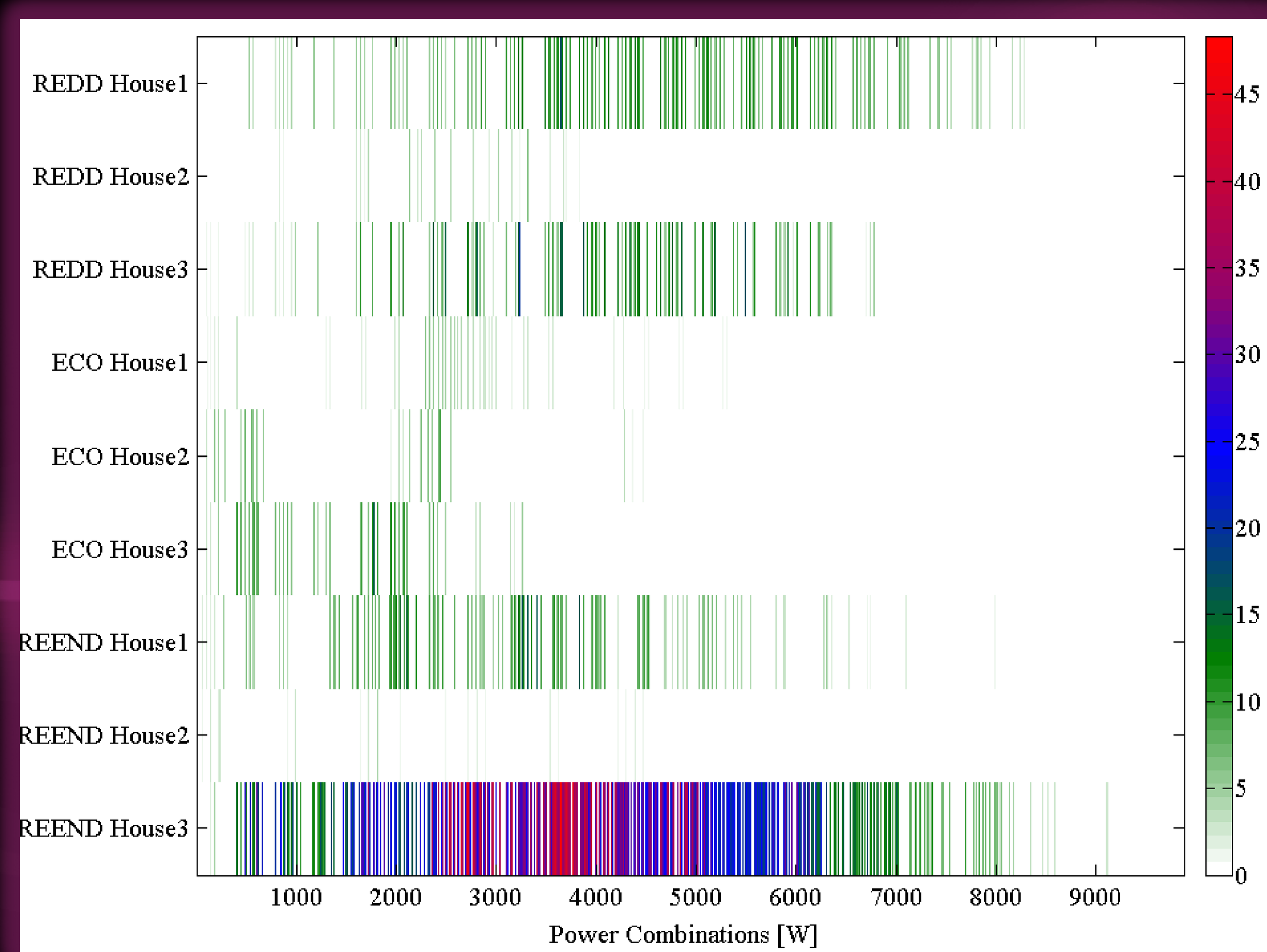
$$C_k = \sum_{j=1}^{M} \mathrm{OVL}(f_{P_k}, f_{P_j}) = \sum_{j=1}^{M} \int_0^{P_M} \min(f_{P_k}(p), f_{P_j}(p))\,\mathrm{d}p$$

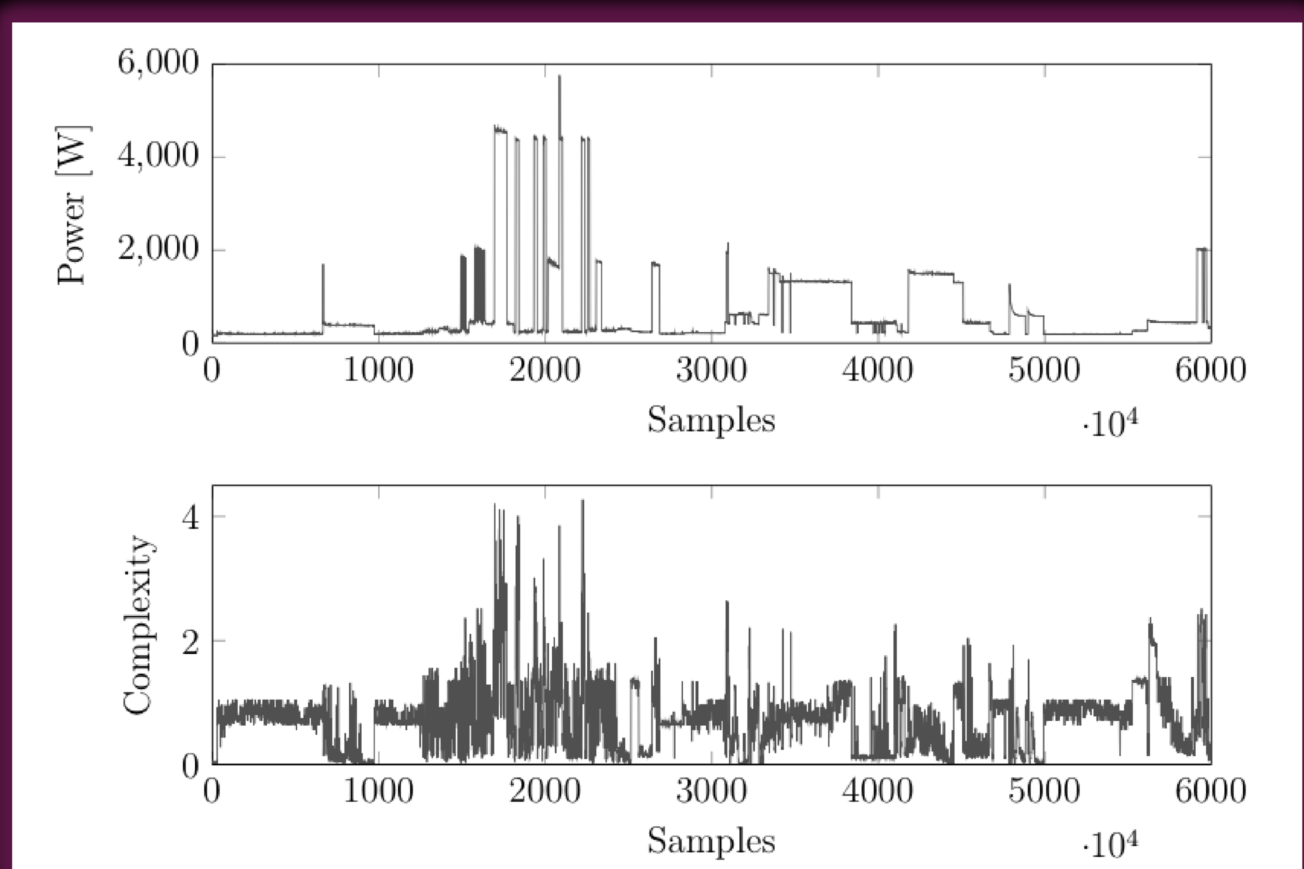


Measured power value are compared to all possible combinations of power values

Tested with different appliance data sets

- 3 datasets: REDD, ECO, GREEND
- 3 houses with 6 different appliances
- 1 second sampling frequency





Time Series Complexity

The appliance set complexity gives feedback about the complexity of the used appliances by comparing their power states and appliance structure. The time series complexity also considers the usage of an appliance

$$C_{total} = \frac{1}{T}\sum_{t=1}^{T} C_t = \frac{1}{T}\sum_{t=1}^{T}\sum_{k=1}^{M} \mathrm{OVL}(f_{P_t}, f_{P_k})$$

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