



Synthetic Aggregate Household Consumption Trace Generation with SHoCo

Malte Mues

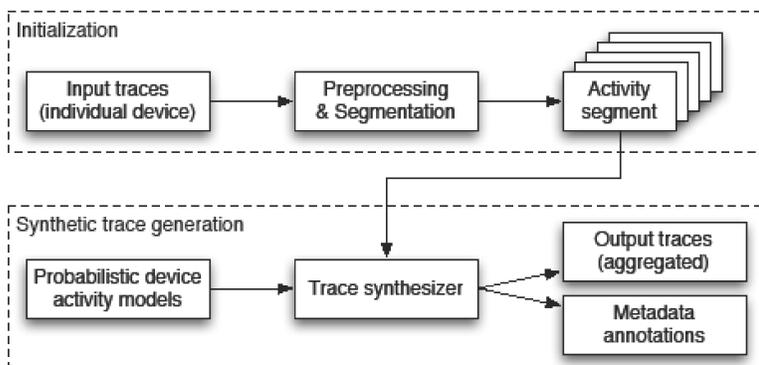
Technische Universität Clausthal, Clausthal-Zellerfeld, Germany, malte.mues@tu-clausthal.de

Andreas Reinhardt

Technische Universität Clausthal, Clausthal-Zellerfeld, Germany, reinhardt@ieee.org

Motivation

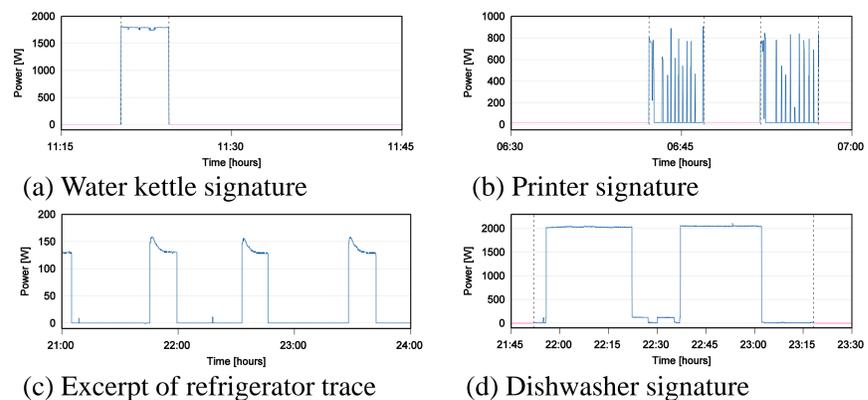
- Smart meters have emerged as invaluable tools for utility companies, as they automated collect **energy consumption readings** and enable multi-tarif billing
- Plug-level power sensors, or **smart plugs**, allow for the automated collection of energy consumption data per device
- Test data including **meta information** to the energy consumption is strongly limited available, so development of new services is blocked
- Collecting energy consumption with a certain characteristic is **expensive** in the field
- SHoCo tackles the challenge to generate semi-synthetic, yet **realistic-looking** household consumption traces based on the **re-combination** of snippets of **existing device-level** consumption traces



Design key benefits

- SHoCo provisions **ground truth annotations** as a separate listing describing all device activities and contained events
- The configuration adapts quick and convenient to generate large set of household consumption traces
- Realism** of generated traces is improved by using extracted parts of actual consumption data instead if fully relying on artificial load signature models
- The traces are therefor semi-synthetic based on 1 Hz sampled input

Device configuration				Temporal model	
Device type	ID	#	Time model	Time	Name
Coffeemaker	3	4	1	07:00 - 08:00	Breakfast
Dishwasher	1	1	1	12:00 - 13:00	Lunch
Toaster	1	6	1		
Refrigerator	1	1	-	18:00 - 20:00	Dinner



Activity Segment Extraction

SHoCo distinguishes four types of appliance with respect to their power consumption:

- first group (a) are on-off devices
- second group (b) consumes constant standby power and spike while in use
- third group (c) have a repetitive pattern over the day
- fourth group (d) operates based on a state machine

Trace Synthesis

- First, random snippets are chosen from the previously extracted activity segments
- Next, a start point is randomly selected for each segment in accordance with the activity period model and saved for the ground truth annotation
- Last but not least, power values of parallel active segments are summed up for trace generation
- The output trace is **sampled with 1 Hz** which correspond to 86400 entries
- A seed can be used to control the random selections, so **reproducibility is guaranteed**
- Alternating the seed value generates similar traces with totally different characteristics

Conclusion

- Automated creation of large number of semi-synthetic consumption traces with realistic appearance
- Temporal models allow to **controlled device activation**
- Precise control on the number of synthesized appliances to adapt it according to the capabilities of the disaggregation algorithm under evaluation

