# PLSIM: An Integrated Plug Load Assessment Tool

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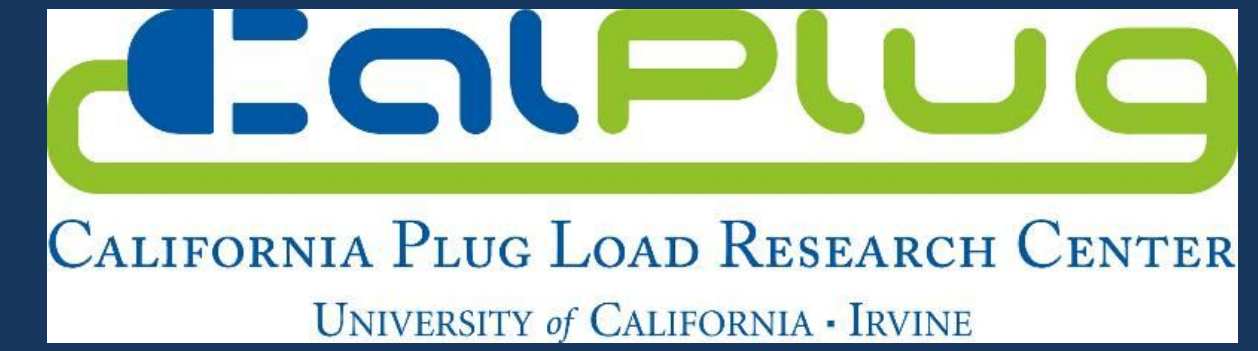
Introduction/ Background

Energy efficiency and utility strategies is a prevalent field of study, especially in today's time. However, accurate energy assessment and visualization for electric devices is not as established as other forms of environmental assessments.
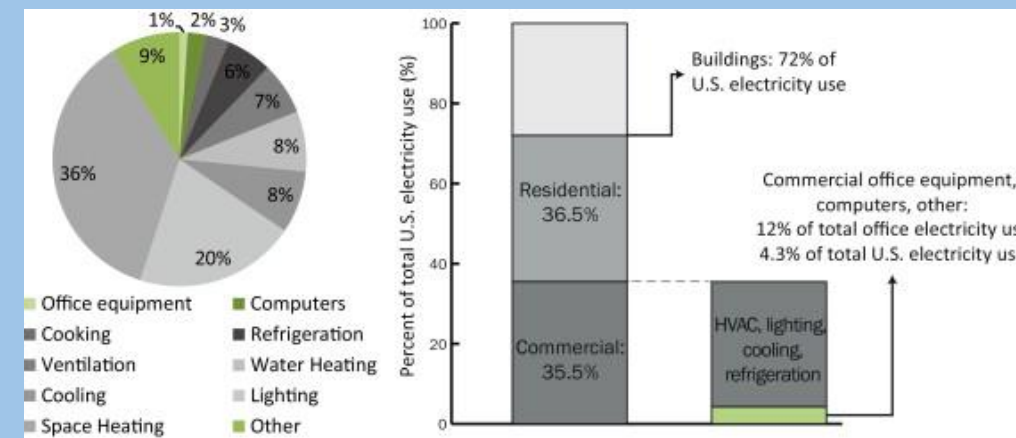

Figure: Energy Scheduling Analysis

It is relevant to organizations involved in overseeing and researching electric power usage because according to the General Services Administration, plug loads may account for 20-50% of the total building energy consumption in the Unites States. With the increase of plug load devices used in work places, it's vital to be properly informed of such amounts of energy usage and make proper energy policy decisions.

PLSim Purpose

PLSim was developed as a utility tool to "simulate how different sets of devices operating in different operating in different states consume energy".
The primary goals of PLSim is:

- Database simulation and calculation based on implemented device libraries
- Highlight operational behavior of devices and how users interact with the devices
- Reproduce a real usage measurement via graphical representation
- Further instigate conversation on the larger impact on social awareness of better energy policy decisions

In this phase of development our team has focused on the subset goal of improving the mobility of the application with what capabilities have been implemented and can be improved upon for overall enhanced user interaction.
With these measurements electrical utilities and researchers can plan accordingly from visualization of how these device usage is modeled.

Application Developement

PLSim 1.1

PLSim 1.1 is focused on creating the initial graphs for power consumed and energy used, as a way of tabulating how different sets of devices operating in different states consume energy. These behavioral profiles are pulled data from the xml database of:

- Amount of time device is used
- The patterns of use
- Power management settings in conjunction with multiple states

PLSim then takes integration times (days or weeks even) to generate these results in CSV files of their usage schedules. These schedules are used to generate the power consumed and energy used measurements.

```
MENU:
a: Add a device
d: delete a device
p: print the devices you have
r: Run the simulation and Quit
q: Quit
```
Figure: Menu Display of PLSim Program

```
Enter integration period: 10

How long is this time interval (in minutes)[enter 0 to end the simulation]: 60
Which of the following states is "PC Laptop Computer|HP|Model 1" in [(1, 'Charger')

How long is this time interval (in minutes)[enter 0 to end the simulation]: 50
Which of the following states is "PC Laptop Computer|HP|Model 1" in [(1, 'Charger')

How long is this time interval (in minutes)[enter 0 to end the simulation]: 0
```
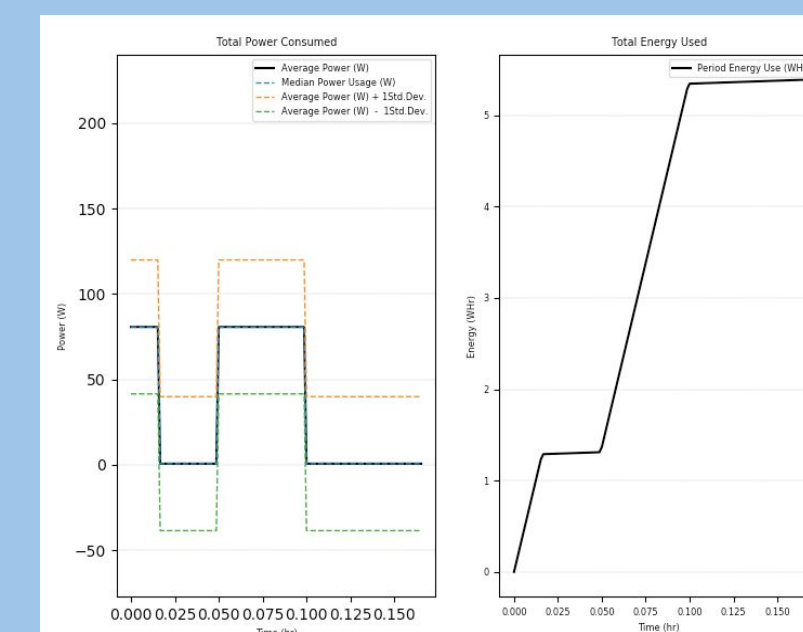Figure: Run Simulation Display

Figure: PLSim 1.1 Simulation Graphs

PLSim 1.2

Building off what was implemented PLSim 1.1 with the same setup, this version introduces object pickling and separation of the simulator in Scheduler and Calculation Engine. This divides the program into device configuration, and calculation/graph simulation to provide easy tabulation of large numbers of profiles to test.
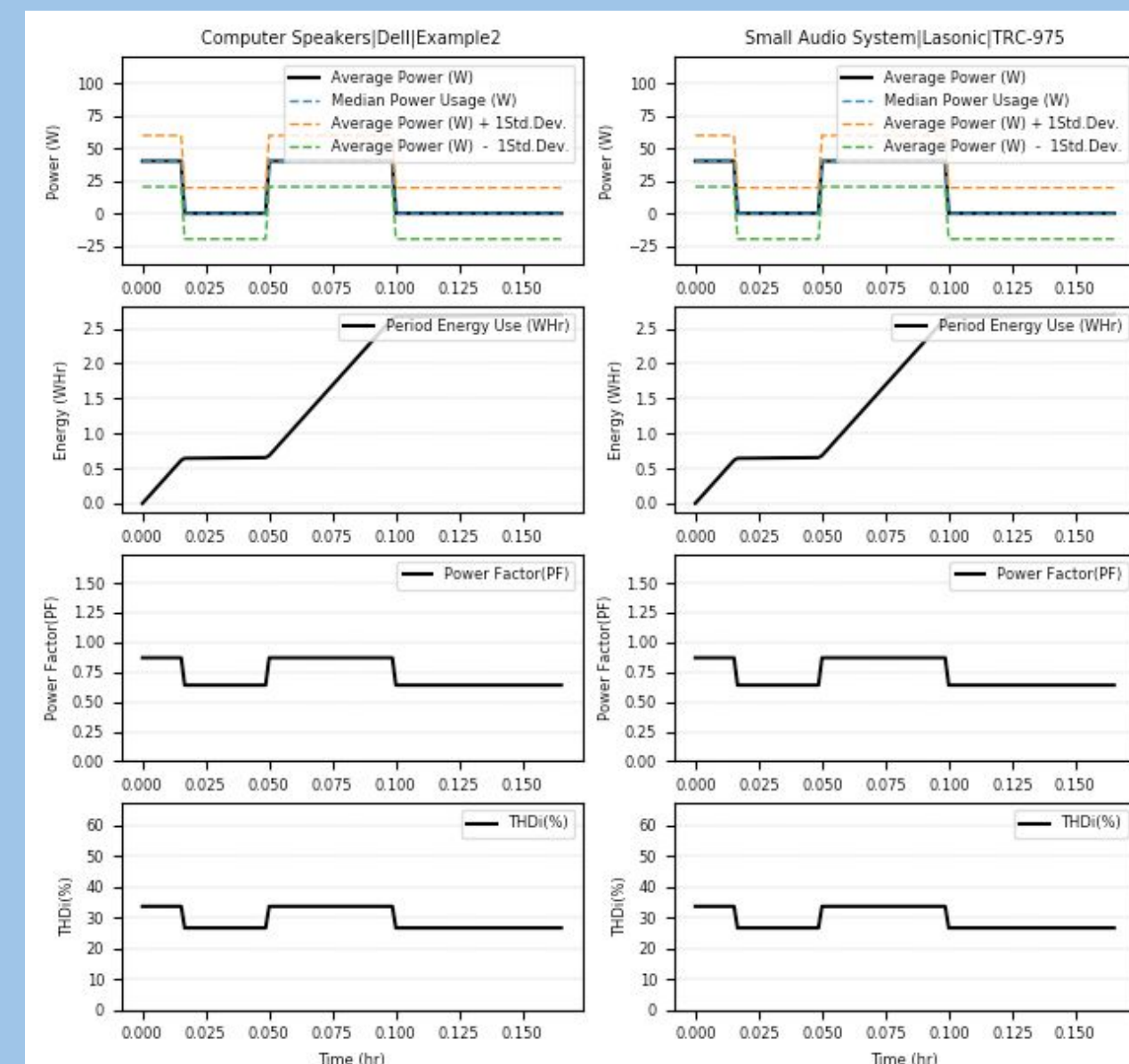

Figure: PLSim 1.2 Simulation Graphs

Testing

Beta testing has been underway under through involved testing of the behavioral profiles and state values.

With understanding how these XML libraries, integration periods and state inputs are used our testing of PLSim is focused on what usage schedule results are being created. Including what these results can tell for energy consumption analysis.

The graphical representation on the right gives a snapshot of the behavioral data being tested in combination with simulation constraints that are streamlined through PLSim.
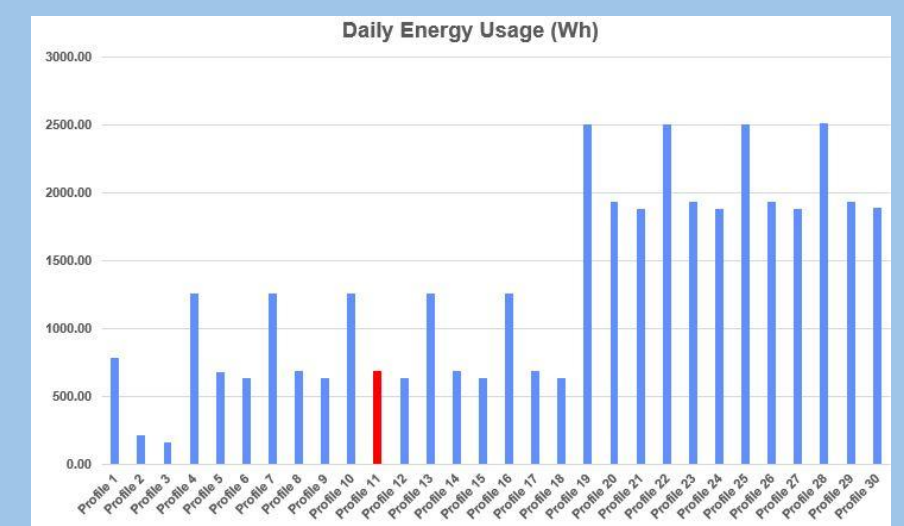

Figure: TV Profile for Energy Usage

Future Work

With the completion of PLSIM 1.1, PLSim 1.2 was developed as a revised version of the distributable software . The newest distributable version is set to be PLSim 2.0 which will include more advanced calculation capabilities such as portable devices and thermal tracking.

One of the future improvements for this software include developing a more comfortable and appealing user interface for users and testers, especially those with no software developing knowledge. This encompasses being able use auto-saved input values and ability to auto-save better resolution output models in a central file for every generation.

Another change that is more large-scale is generating a scheduler for each electric utility used and providing the ability to control the utility from within the hardware/software of the device based on the generated schedule. Future versions of PLSim will be even more powerful and standalone to provide energy assessment capabilities to our clients.

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