

**Recent Progress:**

1. **PSLF License Expires June 30.**
2. Differences in Steady State behavior due to R being on the wrong base.
3. PSDS doesn't account for 'effective droop' in system where not all machines are governed:

$$R_{eff_i} = R_i \frac{\Sigma M_{Base_{GOV}}}{\Sigma M_{Base}}$$

This can be accounted for in LTD via a simulation parameter.

4. Alternate input of System H tested.
5. Six Machine System created to test additional features. (see reverse)
6. Step and ramp perturbances for Loads, Generators, branches, and shunts refined.
7. Logging added to Branch and Shunt Agents.
8. System Slack identified programatically.
9. GitHub updated:  
<https://github.com/thadhaines/>

**Current Tasks:**

1. Continue to Update Code flowchart to aid in further development.
2. Work to incorporate Matt's *Suggested Use Cases* into simulation.
  - Add Timer, Power Plant, and BA agents
  - Work to Define Definite Time Controller, Power Plant, and BA user Input
  - Define Agent actions for AGC/LFC (i.e. ACE / UCE / SCE calculations)
  - Further Refine perturbation Agents for Generator/Slack Agents

**Current Questions:**

1. Units on System Damping are MW\*s/Hz? Should D be defined as Negative or  $\Delta\omega = \omega - 1$  when scaling D?

**Future Tasks:**

- (a) Formulate an experiment utilizing a multi-area model that can be validated with PSDS.
- (b) Formulate feasible plan of action for casting all WECC governors to LTD governors (tgov1). Something like:
  - i. Parse models of interest from dyd.
  - ii. Create dyd from parsed model.
  - iii. Automate a Pref step test for a one machine infinite bus in PSDS.
  - iv. Read output data
  - v. Generate/Calculate LTD equivalent model parameters from results (this will probably use MATLAB and `jfind`)
  - vi. Export custom dyd for LTD simulation. (PSDS would still use original the dyd, though *could* use modified dyd)
- (c) Add import mirror / bypass mirror init sequence option to prevent repeated mirror creations.
- (d) Create an agent for every object: SVD, Transformer, ...
- (e) Investigate line current data and ULTC action in PSLF.

**Matt Requests:**

- (a) Enable multiple dyd files to overwrite / replace previously defined agents/parameters
- (b) Allow for variable time steps.

**Six Machine** The two area six machine model shown in Figure 1 has enough generators to experiment with power plant agents, balancing authorities and AGC control, multiple generators per bus, and numerous available shunts that can be used to control bus voltage.

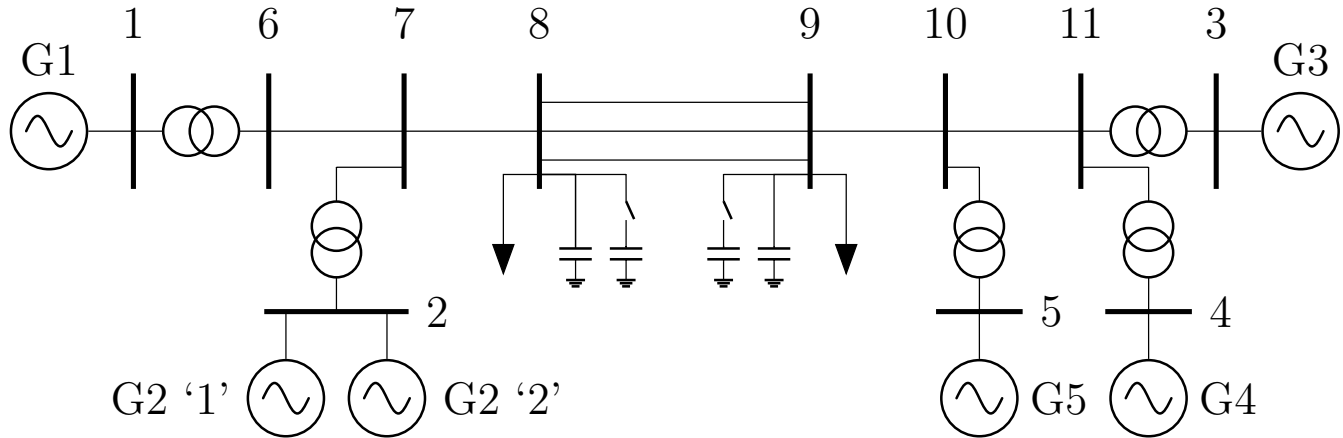


Figure 1: Six Machine System Model.

**Additional Features** The behavior of PSDS to a 5% load ramp on Bus 9 over 40 seconds can be matched fairly closely using LTD<sup>1</sup>. Additionally, system inertia can be scaled<sup>2</sup> and effective droop can be taken into account<sup>3</sup>. The effects of these optional simulation parameters on system frequency are shown in Figure 2.

Note that the plotted theoretical steady state value was calculated using the ideal R values. If effective R values are used for the calculation, the calculated result matches the LTD Reff simulation result.

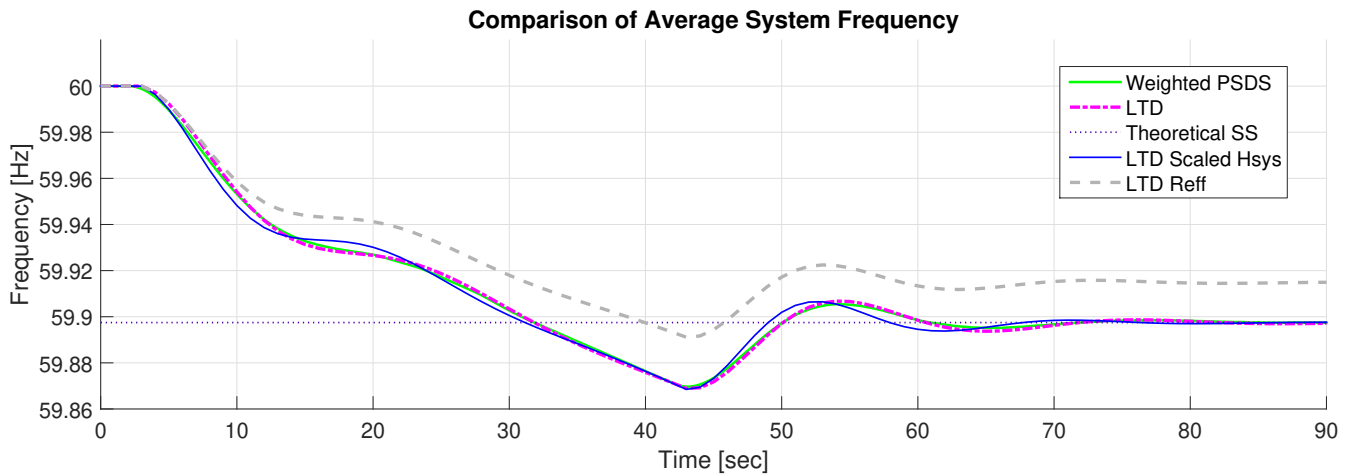


Figure 2: Comparison of LTD system frequency to PSDS weighted frequency.

<sup>1</sup>LTD is using a 1 second time step while PSDS is using a 4.167 ms time step.

<sup>2</sup>Hsys scaled by 75%.

<sup>3</sup>Generator 5 is un-governed.