Recent Progress:

1. Rework tgov1 model to account for `Pref` completed.
2. MiniWECC step test results re-validated using different time steps.
3. AMQP messages now handle a non-converging system gracefully.
4. GitHub updated: `https://github.com/thadhaines/`

Current Tasks:

1. Compile Code flowchart to aid in further development.
2. Work to incorporate Matt's *Suggested Use Cases* into simulation.
   - Add logging to Shunt and Branch Agents
   - Add perturbance Agents for Generator/Slack, Shunt, Branch, ...
   - Define Agent actions for AGC/LFC (i.e. ACE calculations)
   - Think about Shunt Control / Generic Agent control based on system state(s)

Current Questions:

1. Does $\Delta\omega = 1 - \omega$ in $\dot{\omega} = \dfrac{1}{2H_{sys}}\left(\dfrac{P_{acc}}{\omega} - D_{sys}\Delta\omega\right)$?

'Goals':

1. Speed$\longrightarrow$ Order of Magnitude faster than PSDS (not met — only $\approx$3x faster)

Future Tasks:

1. Formulate an experiment utilizing a multi-area model that can be validated with PSDS.
2. Identify System Slack bus programmatically (currently assumes first slack == global slack if > 1 slack found)

   AND/OR calculate system slack error differently → An average of slack errors?
3. Formulate feasible plan of action for casting all WECC governors to LTD governors (tgov1). Something like:
   (a) Parse models of interest from dyd.
   (b) Create dyd from parsed model.
   (c) Automate a Pref step test for a one machine infinite bus in PSDS.
   (d) Read output data
   (e) Generate/Calculate LTD equivalent model parameters from results (this will probably use MATLAB and `jfind`)
   (f) Export custom dyd for LTD simulation. (PSDS would still use original the dyd, though *could* use modified dyd)
4. Add import mirror / bypass mirror init sequence option to prevent repeated mirror creations.
5. Create an agent for every object: SVD, Transformer, ...

Matt Requests:

1. Enable multiple dyd files to overwrite / replace previously defined agents/parameters
2. Allow for variable time steps.

Updated Tgov1 model: Previous attempt at `tgov1` model revisted to account for P_{ref}.

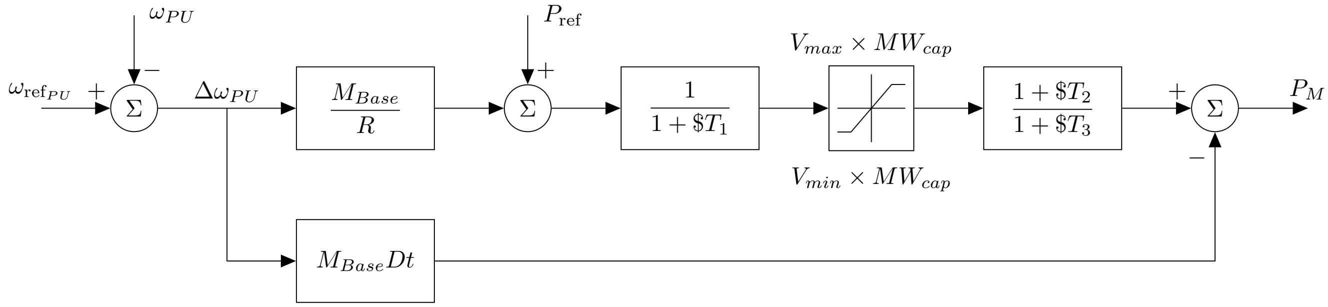

Figure 1: Corrected tgov1 model.

Time step resolution re-validation: The `distPacc` function was corrected to eliminate a number of power-flow solutions and the new `tgov1` model was used for the 90 second 1,200 MW miniWECC step test. LTD is run from the command line, uses no damping, rk45 integration, and a 0.5 MW slack tolerance. The PSDS system has exciters and PSS included.
The theoretical steady state frequency was calculated as

$$f_{ss} = f_{ref} + \Delta f = f_{ref} + \frac{\Delta P}{S_{base}\beta} \tag{1}$$
$$f_{ss} = 1 \text{ Pu} + \frac{-1200 \text{ MW}}{100 \text{ MW} \times 15,555 \text{ Pu}}$$
$$f_{ss} \approx .9992285 \text{ Pu} = 59.9537126 \text{ Hz}$$

When R is a Pu value, β for N governor equipped machines is calculated as

$$\beta = \sum_{i=1}^{N} \frac{1}{R_i \frac{\text{S}_{\text{Base}}}{\text{M}_{\text{Base}_i}}} \tag{2}$$

Additionally, in a system with N generators, the weighted system frequency, f_w, is calculated as

$$f_w \text{ Pu} = \sum_{i=1}^{N} \frac{f_i}{f_{\text{Base}}} \frac{H_i \text{M}_{\text{Base}_i}}{\text{H}_{\text{sys}}} \tag{3}$$
$$\text{where } \text{H}_{\text{sys}} = \sum_{i=1}^{N} H_i \text{M}_{\text{Base}_i} \tag{4}$$

Table 1: Results from MiniWECC load step tests.

	Time step	Simulation Time [sec]	Data File Size [KB]	Real time Speed up	PSDS Speed up	Reduction of file size	Steady State f error [Hz]
PSDS	4.167 ms	56.12	35,070.00	1.60	1.00	1.00	0.0034
LTD	2 sec	9.41	300.00	9.56	5.96	116.90	0.0017
LTD	1 sec	17.39	496.00	5.18	3.23	70.71	0.0017
LTD	0.5 sec	33.05	888.00	2.72	1.70	39.49	0.0017
LTD	0.25 sec	63.67	1,672.00	1.41	0.88	20.97	0.0017

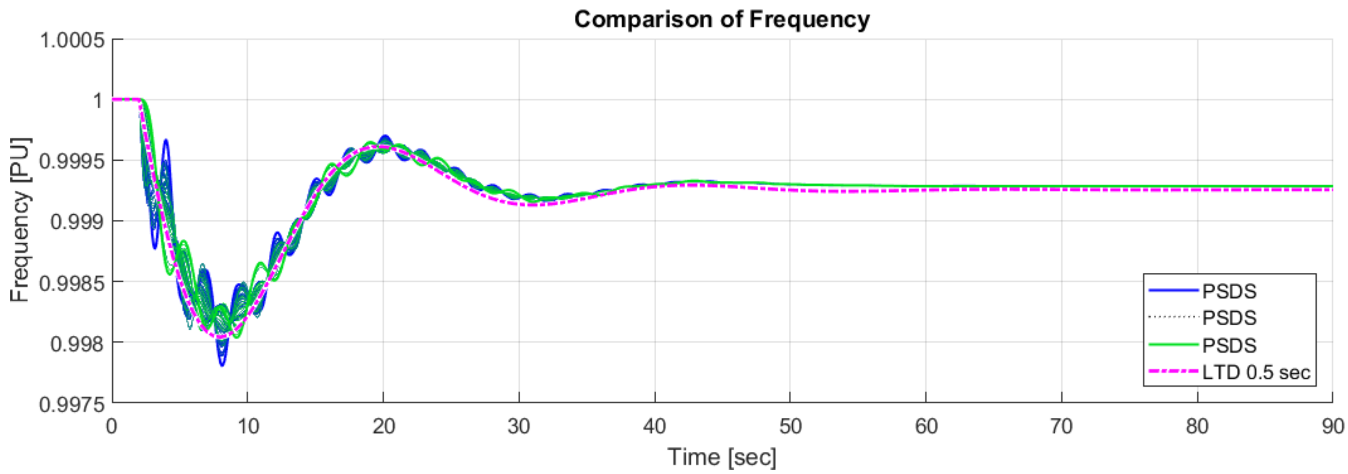

Figure 2: System frequency response to a 1,200 MW load step.

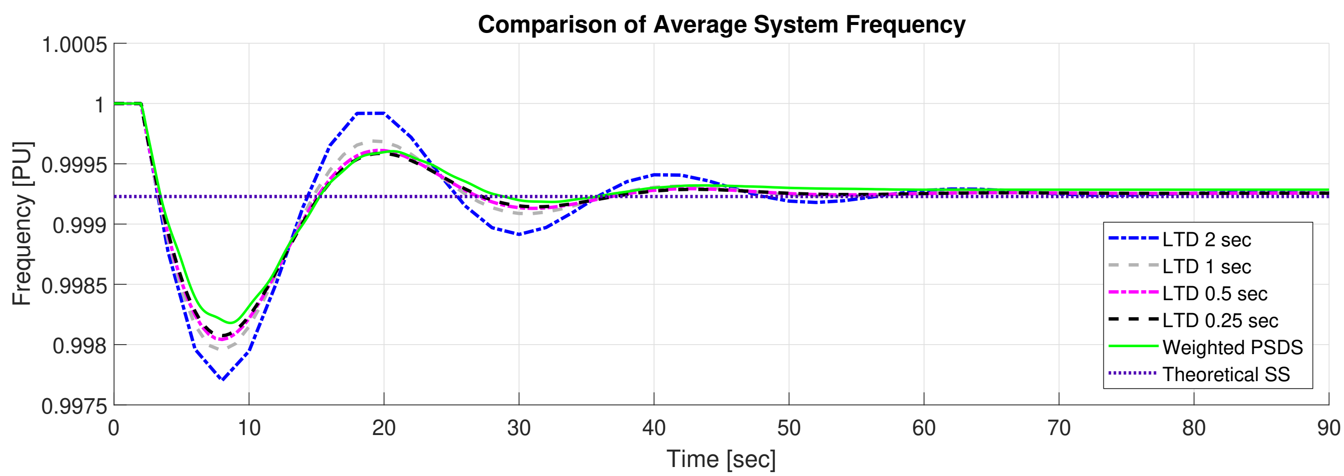

Figure 3: Average frequency of different time steps during a 1,200 MW load step.

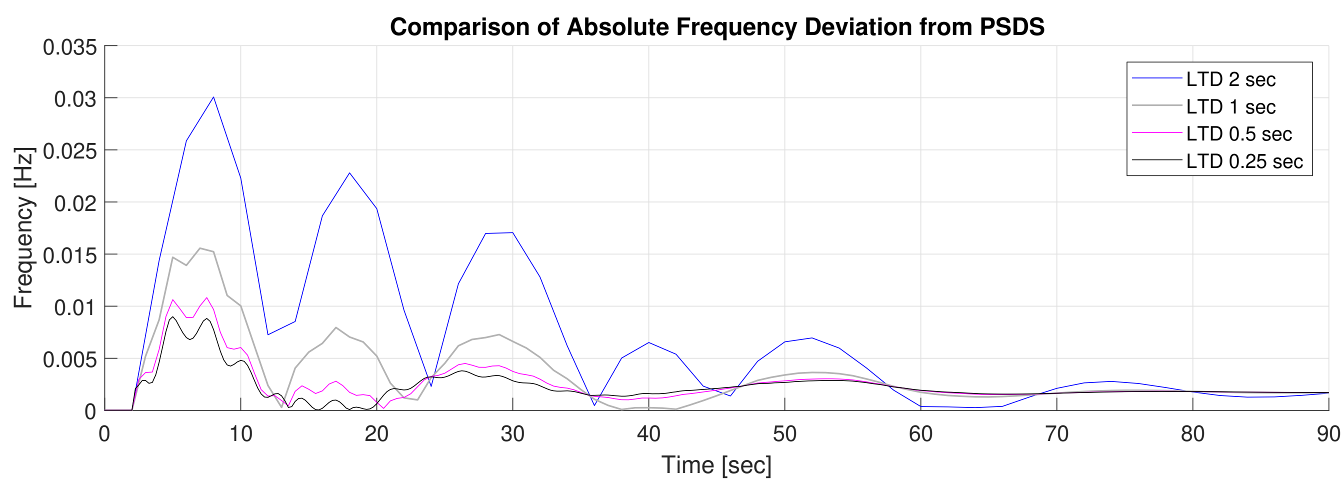

Figure 4: Relative Hz difference of PSDS - LTD $\left(\text{i.e. } \left|f_{PSDS}(t) - f_{LTD}(t)\right| \times 60\text{Hz}\right)$.