

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 perturbation 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)
3. Keep Goals and Requests in mind.

Current Questions:

1. Does $\Delta\omega = 1 - \omega$ in

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

'Goals':

1. Speed \rightarrow 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 \rightarrow 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 revised to account for P_{ref} .

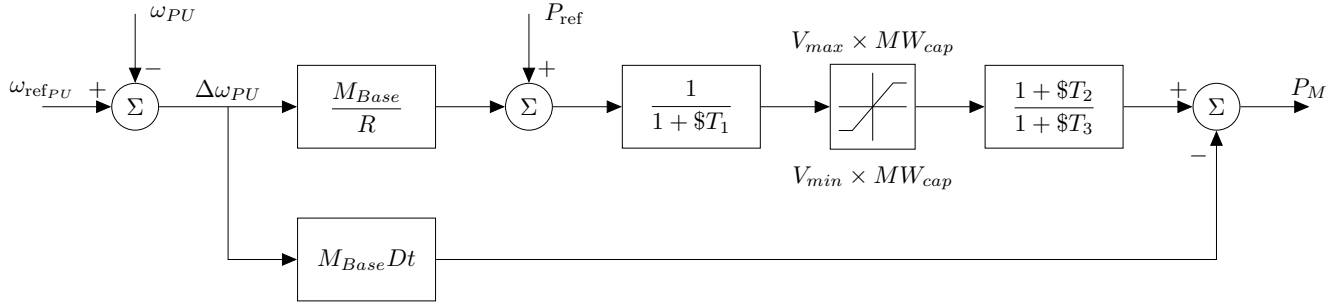


Figure 1: Corrected tgov1 model.

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

$$f_{ss} = f_{ref} + \Delta f = f_{ref} + \frac{\Delta P}{S_{base}\beta} \quad (1)$$

$$f_{ss} = 1 \text{ Pu} + \frac{-1200 \text{ MW}}{100 \text{ MW} \times 15,555 \text{ Pu}}$$

$$f_{ss} \approx .9992285 \text{ Pu} = 59.9537126 \text{ Hz}$$

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

$$\beta = \sum_{i=1}^N \frac{1}{R_i \frac{S_{Base}}{M_{Base_i}}} \quad (2)$$

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

$$f_w \text{ Pu} = \sum_{i=1}^N \frac{f_i}{f_{Base}} \frac{H_i M_{Base_i}}{H_{sys}} \quad (3)$$

$$\text{where } H_{sys} = \sum_{i=1}^N H_i M_{Base_i} \quad (4)$$

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

