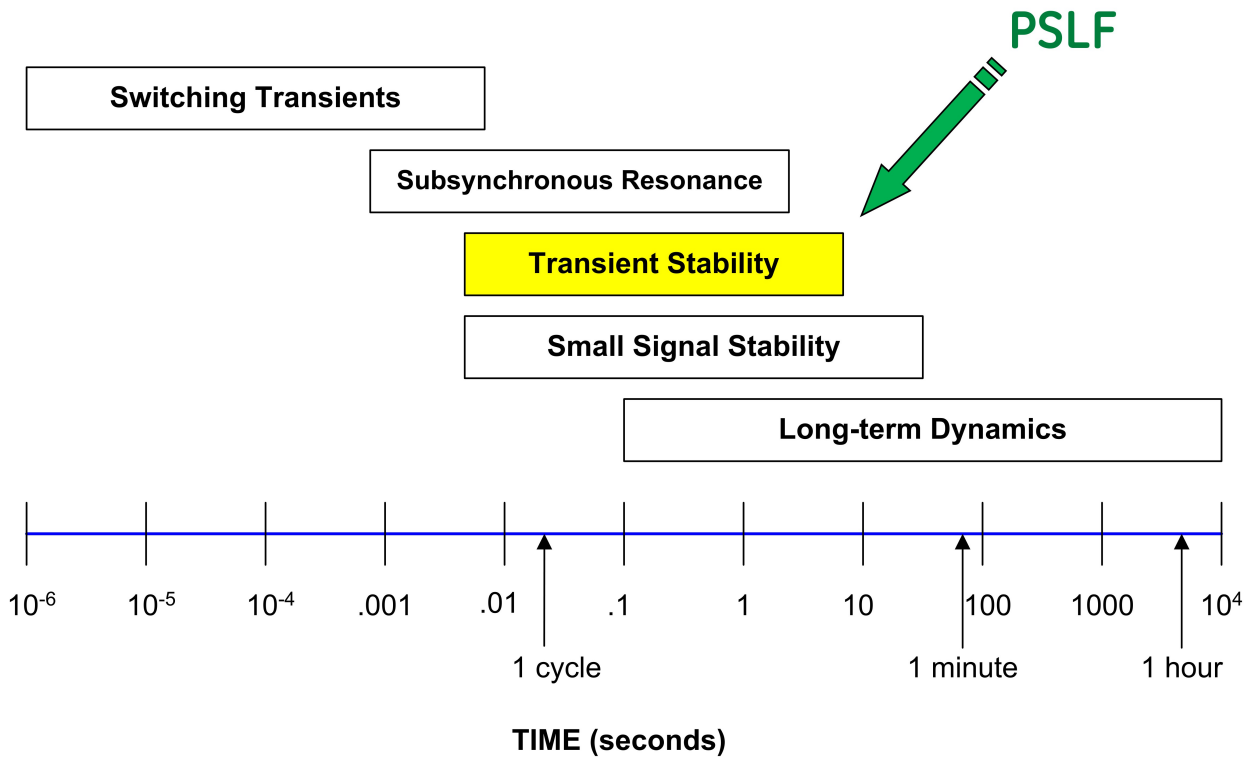
Long-Term Power System Dynamic Simulation using Time Sequenced Power Flows

Thad Haines

Montana Tech - Master's Thesis Research Project

February 1st, 2019

What are long-term dynamics (LTD)? [1]



This simulation assumes:

1. System remains stable.
2. System frequency is described by the combined PU swing equation:

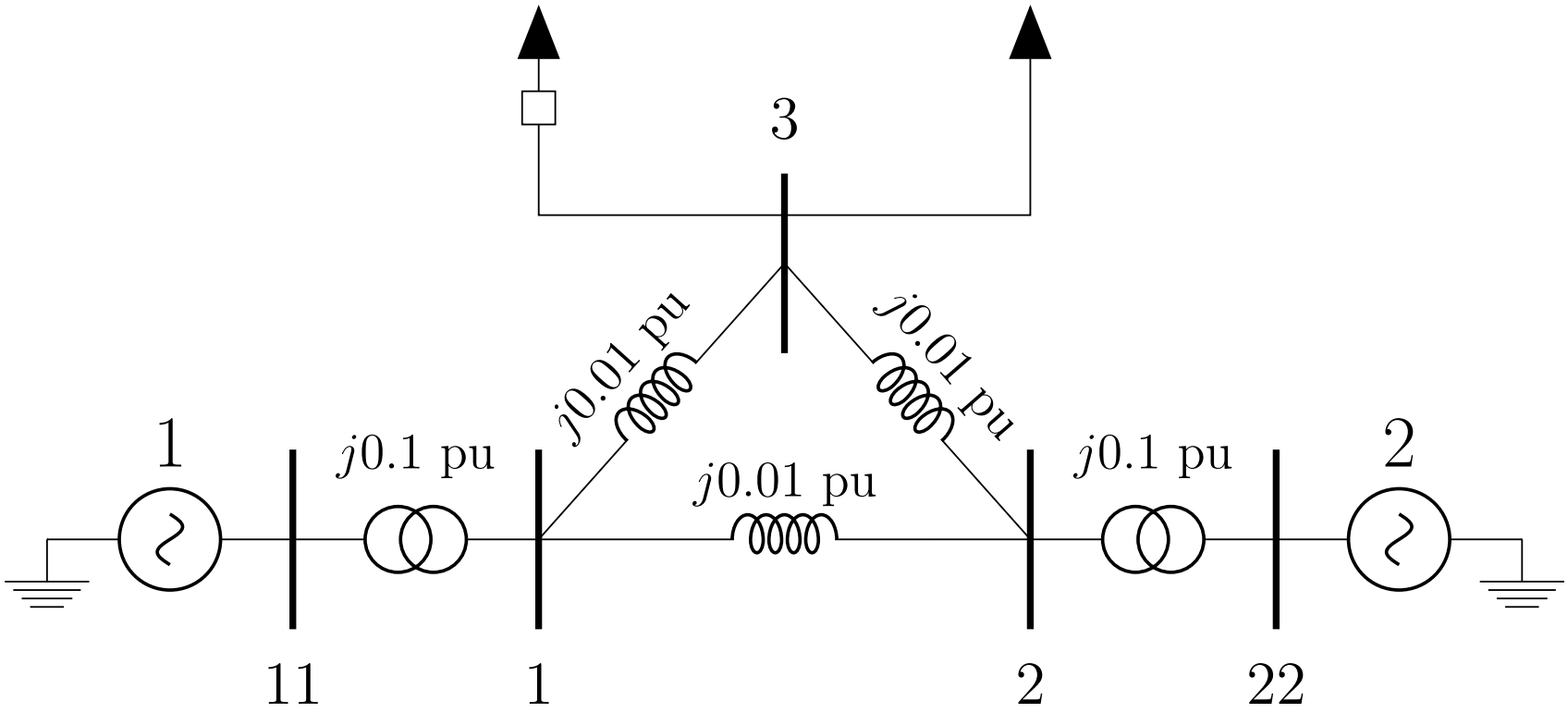
$$\dot{\omega}_{sys} = \frac{1}{2H_{sys}} \left(\frac{P_{acc,sys}}{\omega_{sys}(t)} - D_{sys} \Delta\omega_{sys}(t) \right)$$

3. No system damping $(D_{sys} = 0)$.
4. Time steps of 1 or 0.5 seconds.
5. Fast dynamics are 'mostly' ignored.

Project Goals:

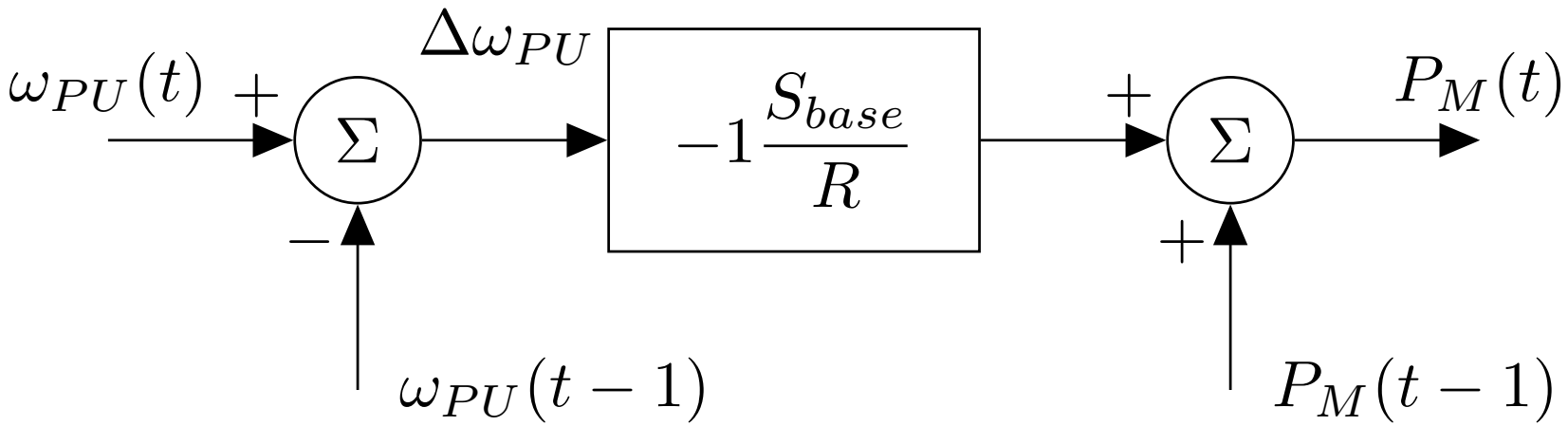
- Develop computer software for LTD simulations using PSLF systems $(.sav)$, dynamic data $(.dyd)$, and customized dynamic models.
- Use software to investigate system reactions that may be impractical to simulate using other approaches.
- Write a master's thesis about it.

PSLF test system:



Generators are identical genrou models.
Gen 1 has a tgov1 governor.

pgov1 : Proportional gain control of P_M



Entered into system via parsed text file:

```
# model   busnum busnam basekv id  : #9 mwcap droop
#!pgov1    11 "11" 22.00 "1 " : #9 mwcap=100.0  0.05
```

Model adapted from [3]

pgov1 on Gen 1, t_{step} =0.5 second