Table of Contents

Using ode15s

```
%clc; clear all; close all

global Load_spline
C = psconstants_will;

% ps = case9_ps_lk_perm;
% ps = updateps(ps);
```

Set up 2 area, 39bus per area case.

```
ps = case39_ps_will;
ps = replicate_case_parallel_gencost_change(ps,2);
ps = updateps(ps);
ps.bus(40:end,C.bu.area) = 2;
%ps.gov(:,C.gov.R)          = ps.gen(:,C.ge.Pmax).*0.05/ps.baseMVA % reg constant is
ps.mac(:,C.ma.Tg)          = ps.gov(:,C.gov.Tg);
ps.mac(:,C.ma.R)           = ps.gov(:,C.gov.R);

load_buses = ps.bus_i(ps.shunt(:,1));
bus_areas  = ps.bus(load_buses,C.bu.area);
```

Set up long term

```
day_in_s     = 24*60*60; %24hrs*60min/hr*60s/min
fivemin_in_s = 5*60;
day_in_5min  = day_in_s/fivemin_in_s;
tmax=60;
tmin=1;

perc_reg   = 1;
ps0        = ps;
nmacs      = size(ps.gen,1);
n          = size(ps.bus,1);
ix         = get_indices_will(n,nmacs); % index to help us find stuff
ps         = find_areas(ps);
ps         = set_ramp_rates(ps);
```

Set up x0/y0 by running one time step of ED to get PGs

```
initial_load      = ps.shunt(:,C.sh.P);
%timestep_check    = [initial_load,initial_load*1.2,initial_load*0.8, initial_load*
[Pgs_sbs,Rgs_sbs] = Econ_Dispatch_fn(ps,(initial_load),perc_reg);
ps.gen(:,C.ge.Pg) = Pgs_sbs %Use first time step's optimized Pg's for
ps                = dcpf(ps)

% prepare the machine state variables
ps.mac = get_mac_state(ps,'linear');
```

        Optimization terminated.
        Optimization terminated.

        ps =

                baseMVA: 100
                    bus: [78x19 double]
                 branch: [94x22 double]
                    gen: [28x22 double]
                  shunt: [38x10 double]
                    mac: [28x23 double]
                    gov: [28x9 double]
                  areas: []
                gencost: [28x7 double]
              frequency: 60
                  bus_i: [239x1 double]
             tie_lines_T: {[2x1 double] [0x1 double]}
             tie_lines_F: {[0x1 double] [2x1 double]}
          bus_tie_locs_T: {[2x1 double] [0x1 double]}
          bus_tie_locs_F: {[0x1 double] [2x1 double]}

        ps =

                baseMVA: 100
                    bus: [78x19 double]
                 branch: [94x22 double]
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                    gov: [28x9 double]
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                gencost: [28x7 double]
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             tie_lines_T: {[2x1 double] [0x1 double]}
             tie_lines_F: {[0x1 double] [2x1 double]}
          bus_tie_locs_T: {[2x1 double] [0x1 double]}
          bus_tie_locs_F: {[0x1 double] [2x1 double]}
                      B: [78x78 double]

Set limits for Diffeq Limiter

```
ps.gen(:,C.ge.reg_ramp_up)    = Rgs_sbs;
ps.gen(:,C.ge.reg_ramp_down) = -Rgs_sbs;
ps.gov(:,C.gov.LCmax)         = ones(nmacs,1); %include the rest of ps.gov?
ps.gov(:,C.gov.LCmin)         = -ones(nmacs,1);
```

form the load

```
[Load_spline,ps] = Load_Type(4,ps,tmax,bus_areas);
total_load = ppval(Load_spline,0:tmax);
ps         = get_ps_areas_libby(ps,bus_areas,load_buses,total_load);
```

Simulate the steady state

```
[t,theta,delta,omega,Pm,ps] = simgrid_lti_lk_perm(ps,[tmin,tmax],1);
```

```
    k =

        0.0060


    num_pos_evals =

        0
```

do some plots

```
subplot_row = 2;
subplot_col = 2;
fontsize = 16;

figure(7); clf;
subplot(subplot_row,subplot_col,1)
plot(t,delta);
axis([tmin tmax -Inf Inf])
set(gca,'FontSize',fontsize)
xlabel('Time')
ylabel('Delta')


%figure(2);clf;
subplot(subplot_row,subplot_col,2)
plot(t,theta);
axis([tmin tmax -Inf Inf])
set(gca,'FontSize',fontsize)
xlabel('Time')
ylabel('Theta')
```

```matlab
%figure(3);clf
subplot(subplot_row,subplot_col,3)
plot(t,omega);
axis([tmin tmax -Inf Inf])
set(gca,'FontSize',fontsize)
xlabel('Time')
ylabel('Omega')

%figure(4);clf;
subplot(subplot_row,subplot_col,4)
plot(t,Pm);
axis([tmin tmax -Inf Inf])
set(gca,'FontSize',fontsize)
xlabel('Time')
ylabel('Pm')

figure(3);clf;
subplot(3,1,1)
plot(t,Pm(:,1))
set(gca,'FontSize',fontsize)
xlabel('Time')
ylabel('Pm')
subplot(3,1,2)
plot(t,Pm(:,2),'g')
set(gca,'FontSize',fontsize)
xlabel('Time')
ylabel('Pm')
subplot(3,1,3)
plot(t,Pm(:,3),'r')
set(gca,'FontSize',fontsize)
xlabel('Time')
ylabel('Pm')

figure(4);clf;
%subplot(subplot_row,subplot_col,5)
plot(t, ppval(Load_spline(1),t),'k')
axis([tmin tmax -Inf Inf])
set(gca,'FontSize',fontsize)
xlabel('Time')
ylabel('Load')

figure;clf;
libby=[5 19];
plot(t,omega(:,libby));
axis([tmin tmax -Inf Inf])
set(gca,'FontSize',fontsize)
xlabel('Time')
ylabel('Omega')
title(['K = ',num2str(ps.areas(1,1))])
ylim([376.988,376.992])


ps.gen(libby,:)
```

```
ans =

  1.0e+03 *

Columns 1 through 7

   0.1340    0.0044         0    9.9990   -9.9990    0.0010    0.1000
   0.2340    0.0044         0    9.9990   -9.9990    0.0010    0.1000

Columns 8 through 14

   0.0010    0.6080         0         0         0         0         0
   0.0010    0.6080         0         0         0         0         0

Columns 15 through 21

   0.0020    0.0082         0    0.1824   -0.1824    0.0044   -0.0044
   0.0020    0.0082         0    0.1824   -0.1824    0.0044   -0.0044

Column 22

   0.0030
   0.0030
```
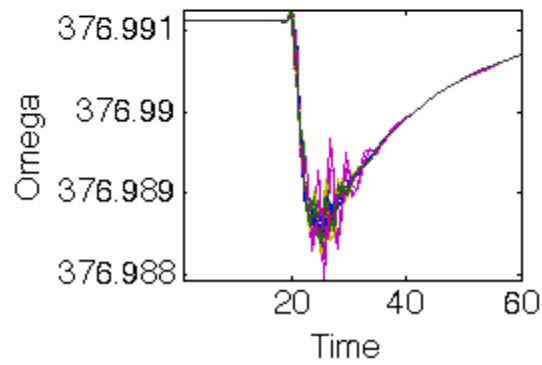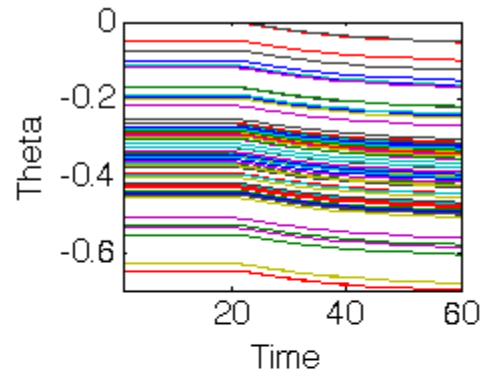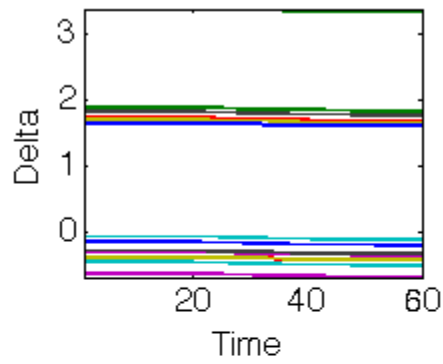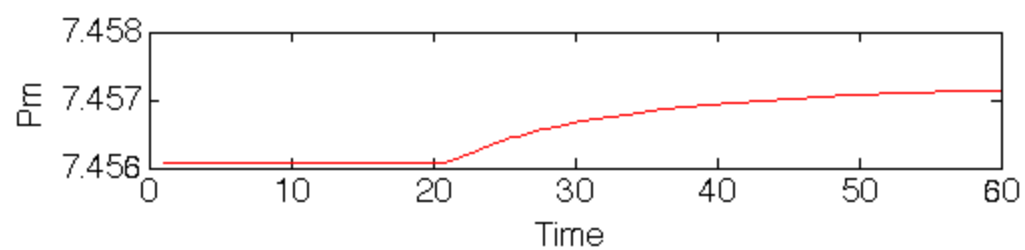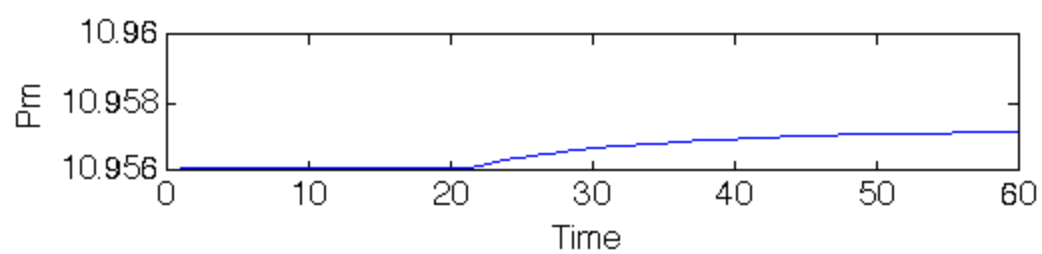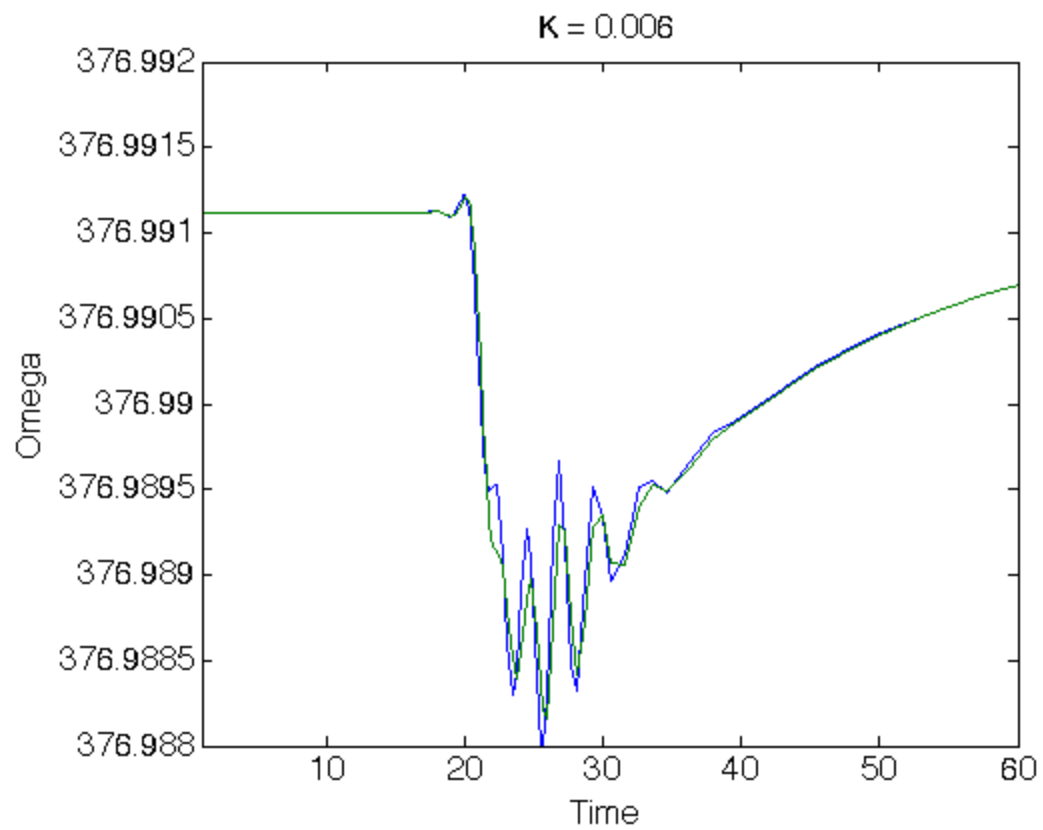
K = 0.006
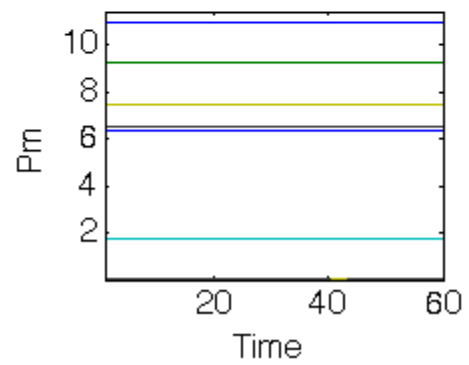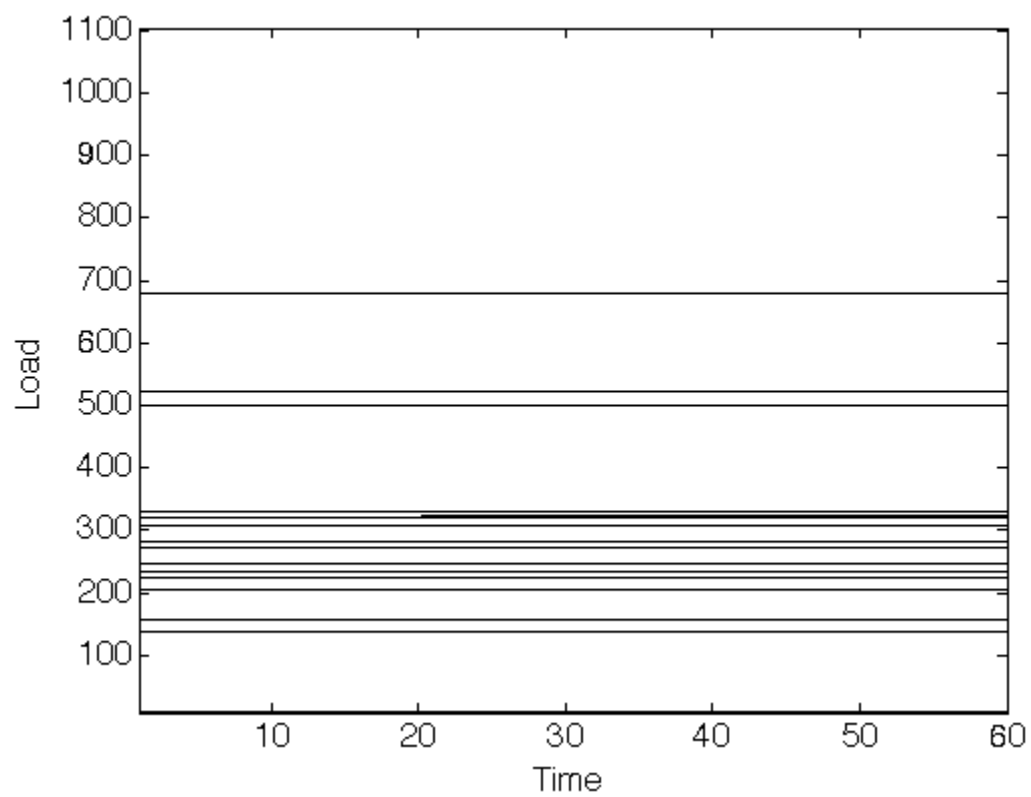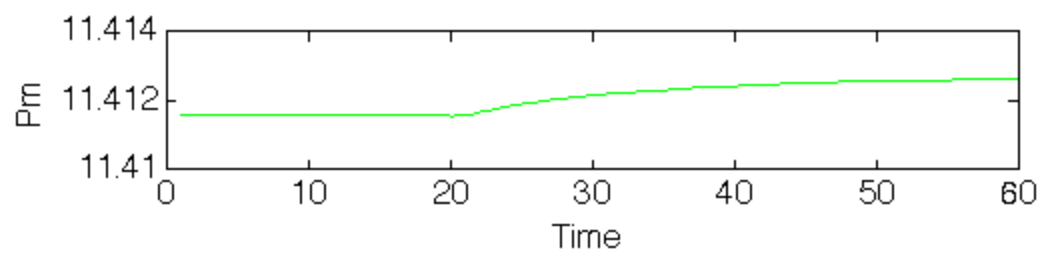
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