Script to Display Power Required and Power Avaialbe

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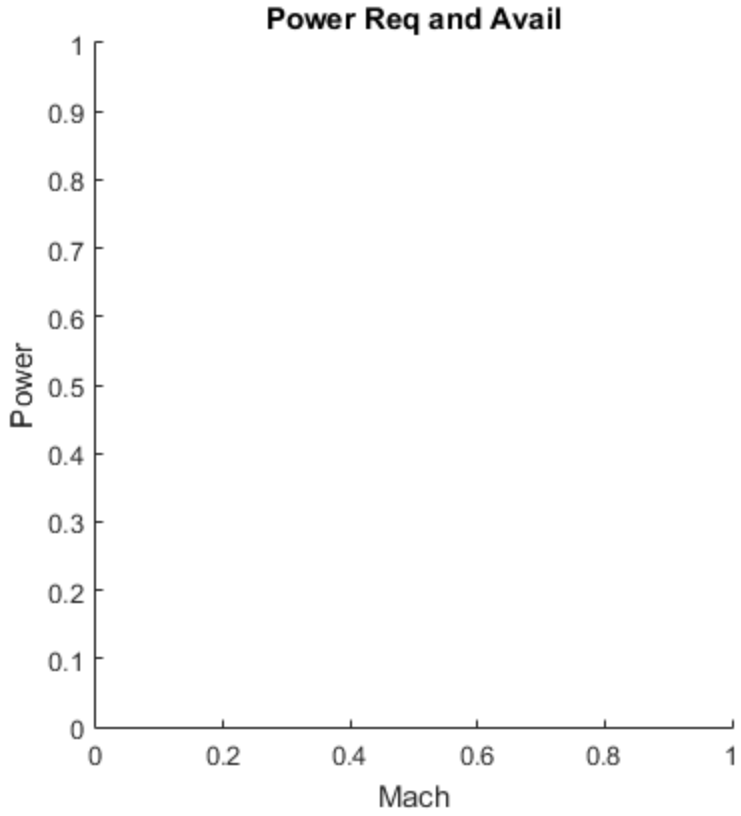
This is only from a propeller standpoint. This is not including the following efficiencies:

```
Motor efficiencies - rpm efficiencies/voltage loses
Transmission efficiencies - power lines from APUs to the motors/speed
control
APUs alternator - assuming APU is 100% from required to provided.
```

Look primarily at mach and alittude effects

Setup

```
clear; clc

prop_const
prop_T
v2=@(v,t,h,pt) sqrt(t/(1/2*p(h)*A(pt))+v.^2);   % velocity ratio,
 velocity, thrust, h
airfoil_polar   % sets up fuselage drag
cd_new      % sets up airfoil drag polar
equations_wash

figure(1)
clf
subplot(1,4,1:3)    % taking up 3/4 of the plot area
xlabel('Mach')
ylabel('Power')
title('Power Req and Avail')
```

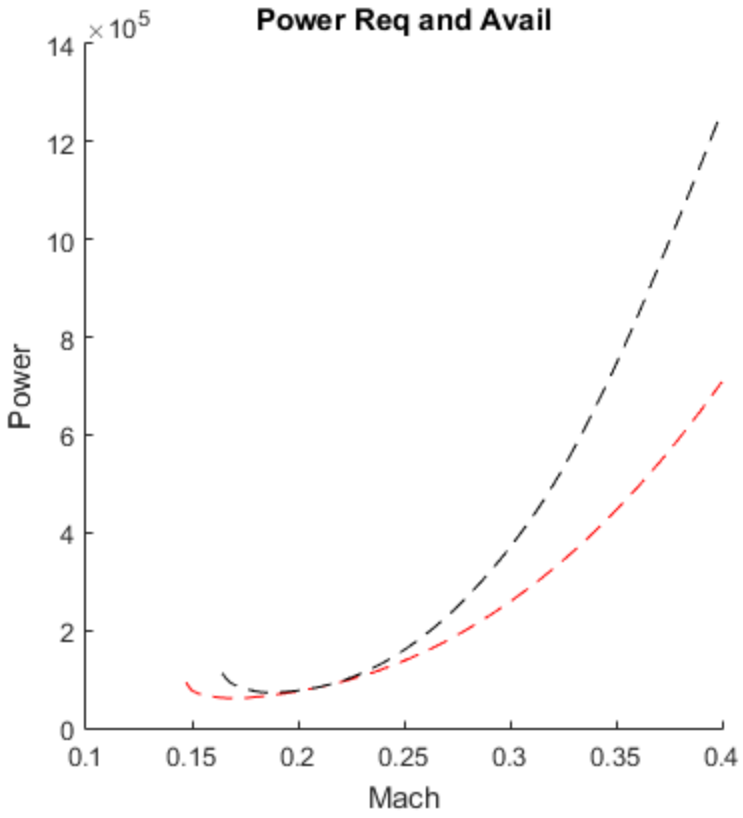


Develop Power Required for SSL Flight Conditions

Lift = Weight at various mach and altitudes

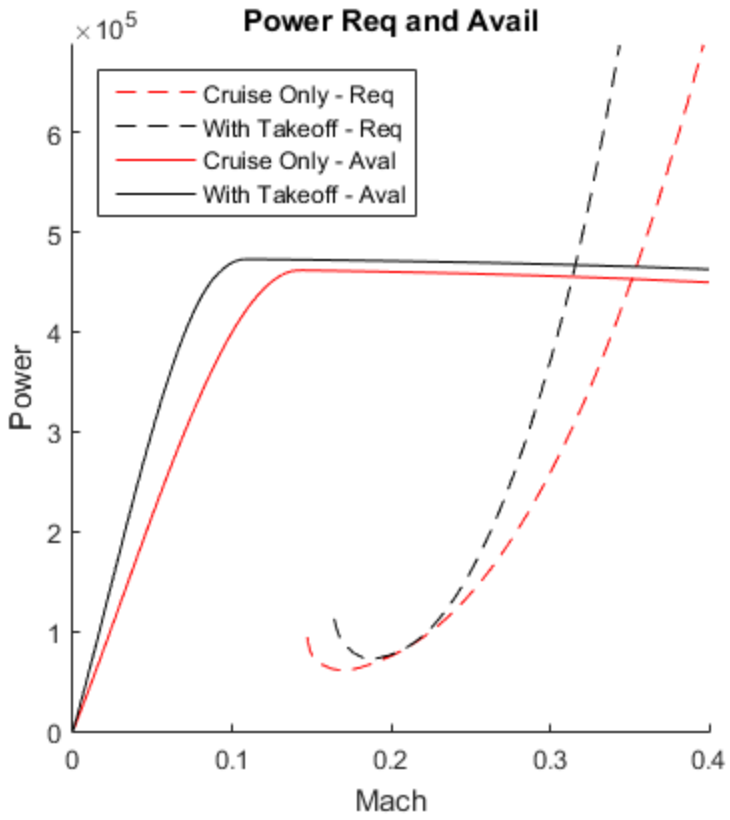
```
numopts=[0,6];
h=0;    % deal with sea-level for now
solopts=optimoptions('fsolve','display','none');
parfor nitr=1:length(numopts)
    min_m=fsolve(@(m) L(15-incd,h,a(h)*m,numopts(nitr)+2)-
W0(19),0.15,solopts);
    [xpp{nitr},ypp{nitr}]=fplot(@(m)...
        D(fsolve(@(aa) L(aa,h,a(h)*m,numopts(nitr)+2)-
W0(19),3,solopts),...
        h,a(h)*m,numopts(nitr)+2)*...
        a(h)*m,[min_m 0.4]);
end

clr=['r','k'];
for nitr=1:length(numopts)
    hold on
    chld{nitr}=plot(xpp{nitr},ypp{nitr});
    chld{nitr}.LineStyle='--';
    chld{nitr}.Marker='none';
    chld{nitr}.Color=clr(nitr);
```

```
end
```



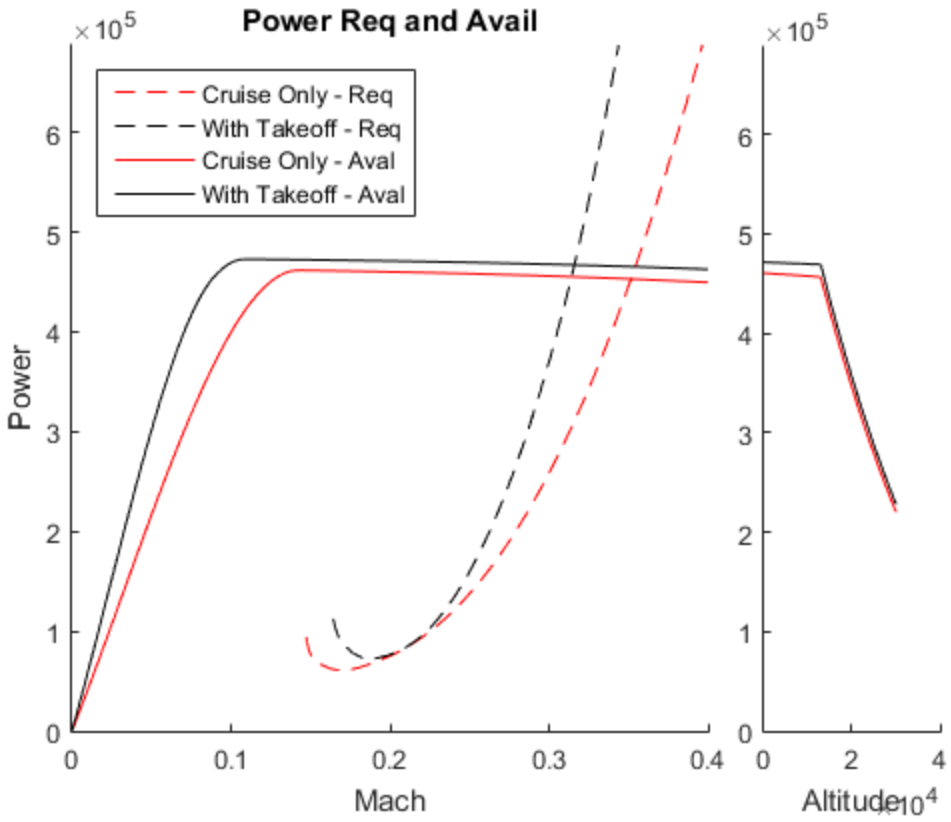
Power Available

```
parfor nitr=1:length(numopts)
    min_m=fsolve(@(m) L(15-incd,h,a(h)*m,numopts(nitr)+2)-
W0(19),0.15,solopts);
    [xa{nitr},ya{nitr}]=fplot(@(m)...
        T(a(h)*m,h,Pa,numopts(nitr)+2)*a(h)*m,[0 0.4]);
end

for nitr=1:length(numopts)
    hold on
    chld{nitr}=plot(xa{nitr},ya{nitr});
    chld{nitr}.LineStyle='-';
    chld{nitr}.Marker='none';
    chld{nitr}.Color=clr(nitr);
end
ylim([0 Pa*1.25])

legend(...
    {'Cruise Only - Req','With Takeoff - Req','Cruise Only -
 Aval','With Takeoff - Aval'},...
    'Location','NorthWest')
```



Altitude Effects

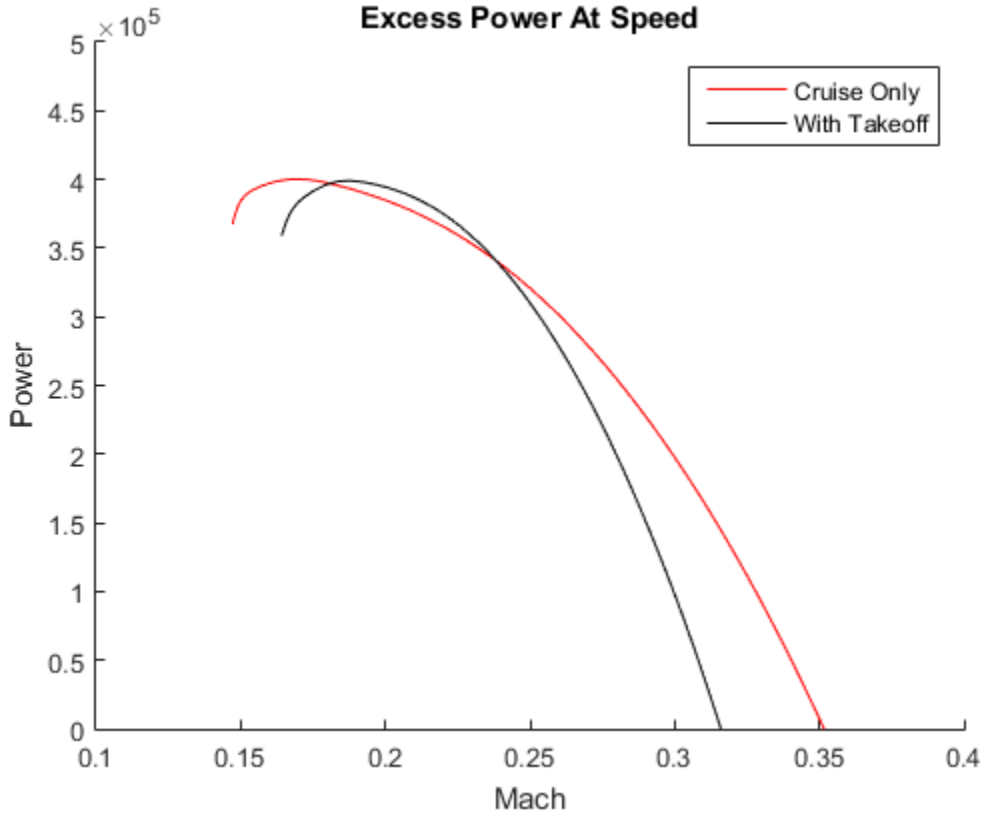
```
subplot(1,4,4)
hold on

parfor nitr=1:length(numopts)
    [xa{nitr},ya{nitr}]=fplot(@(h)...
        T(a(h)*0.2,h,Pa,numopts(nitr)+2)*a(h)*0.2,[0 30e3]);
end

for nitr=1:length(numopts)
    hold on
    chld{nitr}=plot(xa{nitr},ya{nitr});
    chld{nitr}.LineStyle='-';
    chld{nitr}.Marker='none';
    chld{nitr}.Color=clr(nitr);
end
xlabel('Altitude')

ylim([0 Pa*1.25])
```



Excess Power

```
figure(2);
clf
hold on
xlabel('Mach')
ylabel('Power')
title('Excess Power At Speed')

parfor nitr=1:length(numopts)
    min_m=fsolve(@(m) L(15-incd,h,a(h)*m,numopts(nitr)+2)-
W0(19),0.15,solopts);
    [xpp{nitr},ypp{nitr}]=fplot(@(m)...
        T(a(h)*m,h,Pa,numopts(nitr)+2)*a(h)*m-...
        D(fsolve(@(aa) L(aa,h,a(h)*m,numopts(nitr)+2)-
W0(19),3,solopts),...
        h,a(h)*m,numopts(nitr)+2)*a(h)*m,[min_m 0.4]);
end

for nitr=1:length(numopts)
    hold on
    chld{nitr}=plot(xpp{nitr},ypp{nitr});
    chld{nitr}.LineStyle='-';
    chld{nitr}.Marker='none';
    chld{nitr}.Color=clr(nitr);
```

```
end

% set(gca,'YScale','log')
legend(...
    {'Cruise Only','With Takeoff'},...
    'Location','Northeast')

ycc=ylim;
ylim([0 ycc(2)])
```



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