EV Transmission Engineering Tool

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Mass Terms

```
g = 32.2; % [ft/s^2] Acceleration due to gravity

mCar = 1250/g; % [slug] Previous total mass with ICE
mChassis = 650/g; % [slug] Chassis mass (given)
mBattery = 300/g; % [slug] Battery mass
% Quantity of 5 Tesla Model S cells (55 lb per cell)
mDriver = 175*2/g; % [slug] Driver mass (estimate)
mBike = 50/g; % [slug] Bike + bike rack mass (estimate)
mTire = 40/g; % [slug] Tire mass (estimate)
```

Inertia Terms

```
rTire = 21.75/2; % [in] Tire rolling diameter
dGear = 1.4; % [in]
dPinion = 1; % [in]

im = 1.5/12; % [lb ft s^2] Motor inertia (given)
id = 1.6/12; % [lb ft s^2] Driveshaft inertia (given)
% it = mTire*rTire^2;
it = 5/12; % [lb ft s^2] Tire inertia
```

Gear Ratios

```
ratioA = 3.45; % Axle gear ratio(given)
ratioT = dGear/dPinion; % Transmission gear ratio
```

Mass Effective

```
mTotal = mChassis +mBattery + mDriver + mBike;
mEff = mTotal + (1/(rTire/12)^2)*(it+(id*ratioA^2)+(im*(ratioA*ratioT)^2)); % [slug] Endisp('mEff (slug) = ')

mEff (slug) =

disp(mEff);

47.9158

% See hand calculations for derivation of mEff w = mEff*g; % [lbm] Effective weight
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Motor Data

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tm = [127.59]
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7132
7237
7405
7573
7621
7729
7788
7879
7935
80001;
v = ((wm/60)*2*pi()*rTire/12)/(ratioT*ratioA); % [ft/s] Car's linear velocity
```

Aerodynamic Drag Force

```
rho = 0.0765/g; % [slug/ft^3] Density of air
cd = 0.66; % Drag coefficient (given)
aFront = 19.50; % [ft^2] Frontal car area (given)

rAero = 0.5*rho*(v.*(5280/3600)).^2*aFront*cd; % [lbf] Drag force
```

Rolling Resistance

```
fo = 0.02; % [] (parameter given)
fs = 0.0025; % [] (parameter given)

fr = fo + 3.24*fs*((v.*(5280/3600))/100).^2.5; % [lbf] (from Gillespie)
rRollingr = fr*mEff*g; % [lbf] Reaction, rolling rear
rRollingf = rRollingr; % [lbf] Reaction, rolling front
% Note: Flat ground makes front and rear equal
```

Tractive Force Limit of Wheels and Motor

```
mu = 0.8; % [] Tire grip traction limit
cg = 20/12; % [in] Center of gravity (given)
l = 94/12; % [in] Wheel base (given)

wR = 4/1*(1/2*w + cg*rAero+cg*mEff*aFront); % [lbf] Dynamic weight
```

```
ftl = (mu/l*(1/2*w+cg*rAero))/(1-mu*cg/l); % [lbf] Tractive Force Limit
ftm = ratioT*ratioA*tm/(rTire/12); % [lbf] Motor Limit
fTract = min(ftl,ftm); % [lbf]

torque = tm*ratioA*ratioT/(rTire/12);
torqueMax = max(torque);
disp('Tmax (lbf ft) = ');
```

```
Tmax (lbf ft) =
disp(torqueMax);
```

680.0107

Fnet

```
fNet = abs(fTract - rAero - rRollingr - rRollingf);
fNetmax = max(fNet);
disp('Max Force (lbf) = ')
```

```
Max Force (lbf) =
disp(fNetmax);
```

977.7073

TTS 0-60

```
i = 1;
dT = 0;
for i = 1:56

fStep = ((mEff/fNet(i)) + (mEff/fNet(i+1)))/2;

dV = v(i+1) - v(i);

dT = dT + fStep*dV;

end
disp('0-60 t = ');
```

```
0-60 t = disp(dT);
```

17.8405

TTS 65-75

```
i = 1;
dT2 = 0;
for i = 60:68

fStep = ((mEff/fNet(i)) + (mEff/fNet(i+1)))/2;
```

```
dV2 = v(i+1) - v(i);
dT2 = dT2 + fStep*dV;
end
disp('65-75 t = ');
65-75 t =
disp(dT2);
```

4.0426

7