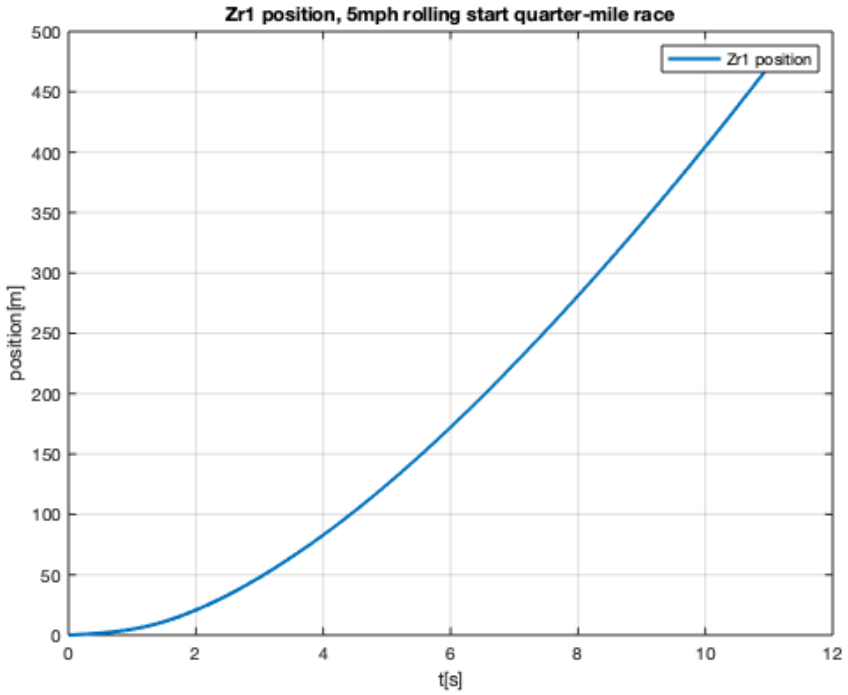
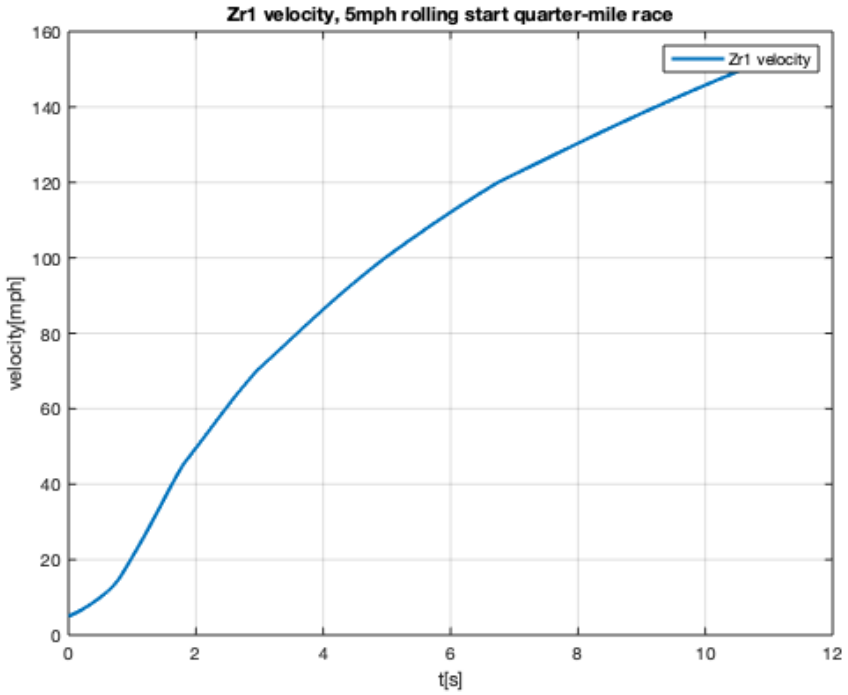
```
Gr_Tran = [4.56;2.97;2.08;1.69;1.27;1.00;0.85;0.65];
Gr_Ax = 2.41;
I_Tran = [0.147;0.113;0.090;0.074;0.051;0.034;0.032;0.029];
I_e = 0.09;
I_d = 0.12;
I_Ax = 0.003;
theta_e_max = 6500;
m = 1665;
g = 9.81;
rho = 1.2754;
h = 1.23;
w = 1.97;
A = h*w;
Cd = 0.28;
fr = 0.015;
Rtf = 0.3268;
Rtr = 0.33775;
It = 1.2;
Eng_speed_RPM = [500;1000;1500;2000;2100;2300;2500;3000;3500;4000;4500;5000;5500;6000;6500];
Eng_speed_radps = (Eng_speed_RPM*2*pi)/60;
HP = [10;40;80;160;220;240;270;330;400;480;540;620;660;670;675];
m_eq_f = (2*It)/Rtf^2;
dt = 0.01;
t = 0:dt:11;
xdot(1) = 5/2.23694;
x(1) = 0;
for a = 1:15;
T_e(1,a) = (HP(a)*746)/(Eng_speed_radps(a));
end
for k = 1:8;
    m_eqdt(k,1) = ((Gr_Ax*Gr_Tran(k))^2*(I_e+I_Tran(k))+Gr_Ax^2*I_d+It)/(Rtr^2);
end
N = length(t);

for k = 1:N-1;
    if xdot(1,k) < (45/2.23694);
         GR = 1;
        engine_speed = (xdot(1,k)*Gr_Ax*Gr_Tran(GR,1))/Rtr;
        T_E = (interp1(Eng_speed_radps,T_e,engine_speed));
        xddot(k) = (((Gr_Ax*Gr_Tran(GR,1)*T_E)/Rtr)-(fr*m*g)-(0.5*rho*Cd*A*xdot(1,k)^2))/(m+m_eq_f+m_eqdt(GR,1));
        xdot(1,k+1) = xdot(1,k) + xddot(k)*dt;
        x(1,k+1) = x(1,k) + xdot(1,k)*dt;

    elseif xdot(1,k)>=(45/2.23694) && xdot(1,k)<(70/2.23694);
        GR = 2;
        engine_speed = (xdot(1,k)*Gr_Ax*Gr_Tran(GR,1))/Rtr;
        T_E = (interp1(Eng_speed_radps,T_e,engine_speed));
        xddot(k) = (((Gr_Ax*Gr_Tran(GR,1)*T_E)/Rtr)-(fr*m*g)-(0.5*rho*Cd*A*xdot(1,k)^2))/(m+m_eq_f+m_eqdt(GR,1));
        xdot(1,k+1) = xdot(1,k) + xddot(k)*dt;
        x(1,k+1) = x(1,k) + xdot(1,k)*dt;

    elseif xdot(1,k)>=(70/2.23694) && xdot(1,k)<(100/2.23694)
        GR = 3;
        engine_speed = (xdot(1,k)*Gr_Ax*Gr_Tran(GR,1))/Rtr;
        T_E = (interp1(Eng_speed_radps,T_e,engine_speed));
        xddot(k) = (((Gr_Ax*Gr_Tran(GR,1)*T_E)/Rtr)-(fr*m*g)-(0.5*rho*Cd*A*xdot(1,k)^2))/(m+m_eq_f+m_eqdt(GR,1));
        xdot(1,k+1) = xdot(1,k) + xddot(k)*dt;
        x(1,k+1) = x(1,k) + xdot(1,k)*dt;

    elseif xdot(1,k)>=(100/2.23694) && xdot(1,k)<(120/2.23694)
        GR = 4;
        engine_speed = (xdot(1,k)*Gr_Ax*Gr_Tran(GR,1))/Rtr;
        T_E = (interp1(Eng_speed_radps,T_e,engine_speed));
        xddot(k) = (((Gr_Ax*Gr_Tran(GR,1)*T_E)/Rtr)-(fr*m*g)-(0.5*rho*Cd*A*xdot(1,k)^2))/(m+m_eq_f+m_eqdt(GR,1));
        xdot(1,k+1) = xdot(1,k) + xddot(k)*dt;
        x(1,k+1) = x(1,k) + xdot(1,k)*dt;
```

```
    elseif xdot(1,k)>=(120/2.23694) && xdot(1,k)<(160/2.23694)
         GR = 5;
        engine_speed = (xdot(1,k)*Gr_Ax*Gr_Tran(GR,1))/Rtr;
        T_E = (interp1(Eng_speed_radps,T_e,engine_speed));
        xddot(k) = (((Gr_Ax*Gr_Tran(GR,1)*T_E)/Rtr)-(fr*m*g)-(0.5*rho*Cd*A*xdot(1,k)^2))/(m+m_eq_f+m_eqdt(GR,1));
        xdot(1,k+1) = xdot(1,k) + xddot(k)*dt;
        x(1,k+1) = x(1,k) + xdot(1,k)*dt;


    elseif xdot(1,k)>=(160/2.23694) && xdot(1,k)<(200/2.23694)
         GR = 6;
       engine_speed = (xdot(1,k)*Gr_Ax*Gr_Tran(GR,1))/Rtr;
        T_E = (interp1(Eng_speed_radps,T_e,engine_speed));
        xddot(k) = (((Gr_Ax*Gr_Tran(GR,1)*T_E)/Rtr)-(fr*m*g)-(0.5*rho*Cd*A*xdot(1,k)^2))/(m+m_eq_f+m_eqdt(GR,1));
        xdot(1,k+1) = xdot(1,k) + xddot(k)*dt;
        x(1,k+1) = x(1,k) + xdot(1,k)*dt;

    else
         GR = 7;
       engine_speed = (xdot(1,k)*Gr_Ax*Gr_Tran(GR,1))/Rtr;
        T_E = (interp1(Eng_speed_radps,T_e,engine_speed));
        xddot(k) = (((Gr_Ax*Gr_Tran(GR,1)*T_E)/Rtr)-(fr*m*g)-(0.5*rho*Cd*A*xdot(1,k)^2))/(m+m_eq_f+m_eqdt(GR,1));
        xdot(1,k+1) = xdot(1,k) + xddot(k)*dt;
        x(1,k+1) = x(1,k) + xdot(1,k)*dt;

    end
end
figure (1)
    plot(t,x,'linew',2)
    grid on
    xlabel('t[s]')
    ylabel('position[m]')
    title('Zr1 position, 5mph rolling start quarter-mile race')
    legend('Zr1 position')
    figure(2)
    plot(t,xdot*2.23694,'linew',2)
    xlabel('t[s]')
    ylabel('velocity[mph]')
     title('Zr1 velocity, 5mph rolling start quarter-mile race')
     legend('Zr1 velocity')
    grid on


t_60 = interp1(xdot,t,60/2.23694);
t_100 = interp1(xdot,t,100/2.23694);
t_quart = interp1(x,t,0.25*1609.34);
format short

fprintf('it takes %f s for the ZR1 to reach 60 mph.\n',t_60)
fprintf('it takes %f s for the ZR1 to reach 100 mph.\n',t_100)
fprintf('the ZR1 completes the quarter mile in %f s.\n',t_quart)
```

```
it takes 2.466725 s for the ZR1 to reach 60 mph.
it takes 4.971312 s for the ZR1 to reach 100 mph.
the ZR1 completes the quarter mile in 9.965449 s.
```





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