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% EMEC 303 Project 1

% Function to calculate forces in the r and theta direction, as well as
% updated mass

function [force_r,force_theta,m] = force(t,rho,phi,vr,w,r,t_m)

% Call mass_thrust_area function
[m,thrust,A,phi] = mass_thrust_area(t,phi);

v = sqrt(vr^2+(r*w)^2);

% Contstants
m_earth = 5.972e24; % Mass of earth (kg)
Cd      = 0.5;      % Drag coefficient
G       = 6.67e-11; % Gravitational constant

% Force calculations

% Force due to thrust and air resistance
force_tan   = t_m*thrust - 0.5*rho*v^2*Cd*A;

% Force in the r direction + m*r*w^2
force_r     = force_tan*sin(phi) - G*m_earth*m/r^2;

% Force in the theta direction
force_theta = force_tan*cos(phi);

end

function [m,thrust,A,phi] = mass_thrust_area(t,phi)

% Constant time values
t_boost   = 126;    % Boosters detatch
t_tank    = 510;    % Fuel tank detatches

% Constant mass values
m_shuttle = 110000;                 % Shuttle
m_tank    = 26535;                  % Fuel Tank
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m_boost   = 68000*2;                % Boosters
m_lfuel   = (756000-m_tank);        % Liquid fuel
m_sfuel   = ((571000*2)-(m_boost)); % Solid fuel

% Constant cross sectional areas
A_shuttle = pi*(5/2)^2;     % Shuttle
A_tank    = pi*(8.4/2)^2;   % Tank
A_boost   = pi*(3.71/2)^2;  % Boosters

if t < t_boost  % Calculate mass thrust and area before boosters detatch

    m      = m_shuttle + m_tank + m_lfuel*(1-t/t_tank)...
             + m_boost + m_sfuel*(1-t/t_boost);
    thrust = 2*12500*1000 + 5250*1000;
    A      = A_shuttle + A_tank + 2*A_boost;

elseif (t_boost <= t) && (t < t_tank)

    % Calculate mass thrust and area after boosters detatch
    m      = m_shuttle + m_tank + m_lfuel*(1-t/t_tank);
    thrust = 5250*1000;
    A      = A_shuttle + A_tank;
    %phi    = deg2rad(10);

else  % Calculate mass thrust and area after fuel tank detatches

    m      = m_shuttle;
    thrust = 0;
    A      = A_shuttle;

end
end
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