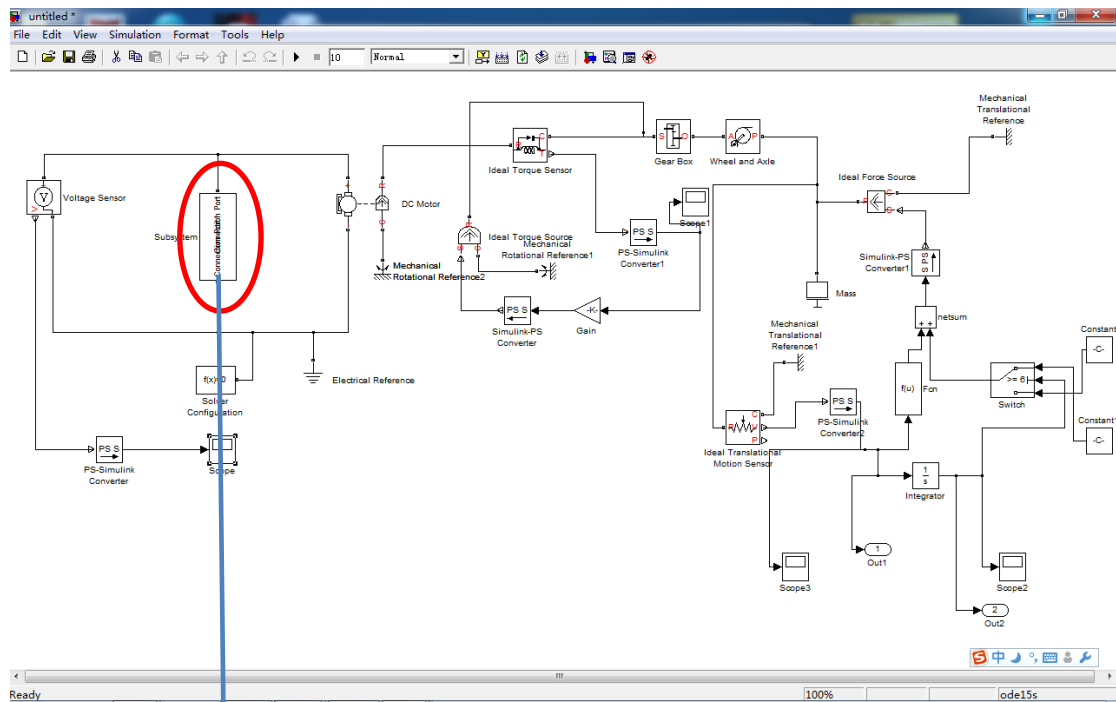


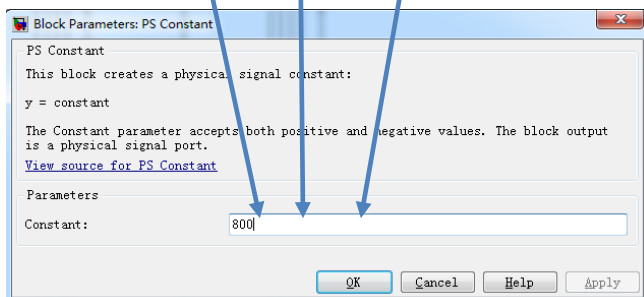
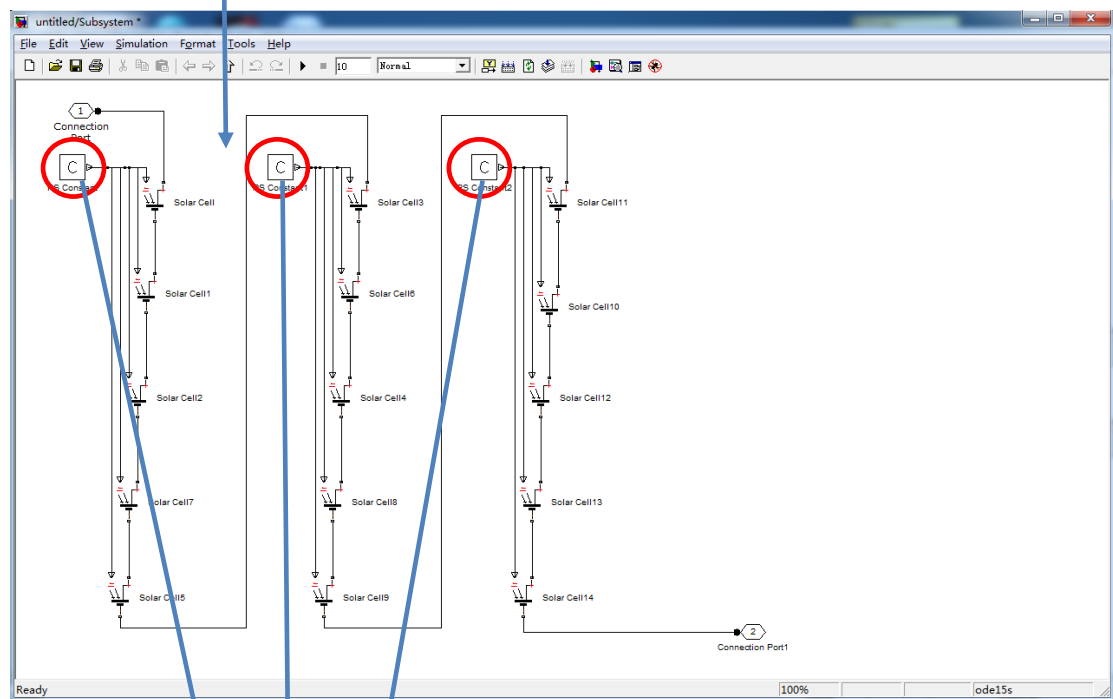
Simulink report



Part 1-Simulink1



We build a system which is made up of 15 solar cells.



Every solar cell is given by a constant number 800.

Most parameters are given by script.

The image shows four screenshots of Simulink parameter dialog boxes:

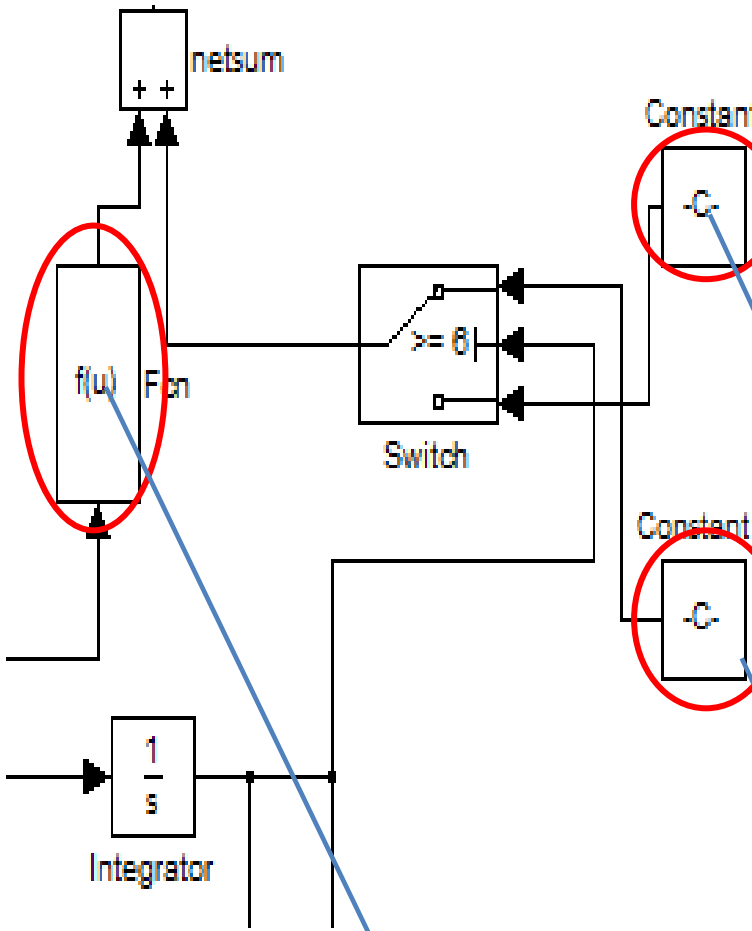
- Block Parameters: Mass:** The 'Mass' parameter is set to 1 kg and 'Initial velocity' is set to 0 m/s. These are circled in red.
- Block Parameters: Gear Box:** The 'Gear ratio' parameter is set to 8.94. This is circled in red.
- Block Parameters: DC Motor (top-left):** The 'Model parameterization' is set to 'By equivalent circuit parameters'. This is circled in red.
- Block Parameters: DC Motor (top-right):** The 'Rotor inertia' is set to 4.29 g*cm². This is circled in red.

Below the screenshots is a MATLAB script in the Editor window. Blue arrows point from the red circles in the screenshots to the corresponding parameter assignments in the script:

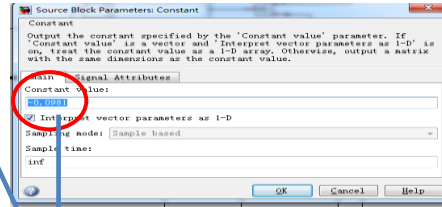
- From the Mass dialog to line 13: `m=1; % kg`
- From the Gear Box dialog to line 14: `r = 0.04; % wheel radius [m]`
- From the DC Motor dialog (top-left) to line 7: `Ra = 3.2 ; %ohm`
- From the DC Motor dialog (top-right) to line 10: `Im = 4.29e-7 ; % kgm^2`

```

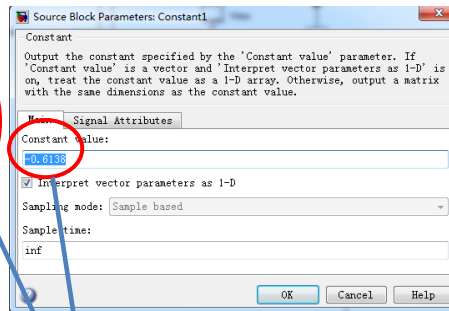
1 %%% Solar Power
2 Ir = 1000; % W/m^2
3 Isc = 0.91; %Ampere
4 Voc=0.6; %Volt
5 N = 1.5;
6 %%% Motor parameters
7 Ra = 3.2 ; %ohm
8 Kt= 6.876e-4 ; %Nm/A
9 La=0.000222 ; %H
10 Im = 4.29e-7 ; % kgm^2
11 Cm = 1e-8 ; % Nm/(rad/s)
12 %%% SSV parameter
13 m = 1; % kg
14 r = 0.04; % wheel radius [m]
15 n = 8.94 ; % gear ratio
16
17 tn=[]; %% initialize empty vector
18 result=[];
19
20 for n=1:20
21 tn=[tn n]; %% Extend vector with gear ratio n
22
23 sim('untitled',10); % Simulate Simulink model for 10 sec.
24
25 [i,j]=find(yout(:,2)>14); % find when position of 14 m is achieved
26 if isempty(i)
27 result=[result 10]; %% if not achieved take time =10 sec
28 else
29 result=[result tout(i(1))]; %% put travel time in vector
30
31 end
32 end
33
34 figure(1)
35
36 result=[result tout(i(1))]; %% put travel time in vector
37
38 end
39
40 figure(1)
41 plot(tn,result,'*') %% plot gear ratio versus travel time
42 [opt,i]=min(result); %% find minimal travel time
43
44 n=tn(i); %% take gear ratio corresponding with minimal travel time
45 sim('untitled',10);
46
47
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```



We build a switch which is given two constant. When displacement is smaller than 6, the system will work with the constant above. Otherwise the system will work with the one below.



what displayed is:
-Crr*m*g=-0.981



What displayed is:
-Crr*m*g*cosθ -m*g*sinθ =-0.6138

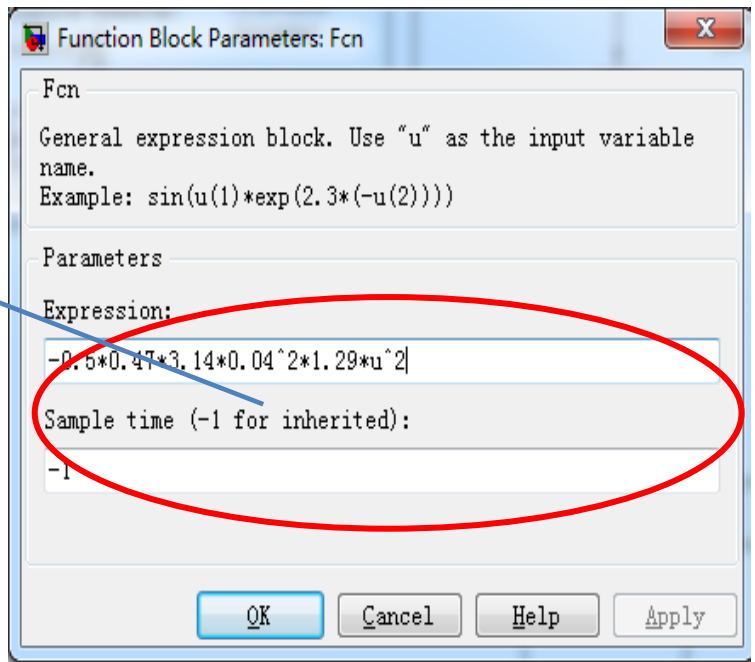
We also build a function to give a air resistance to the car.

Air resistance (no wind):

$$F_w = \frac{1}{2} \cdot C_w \cdot A \cdot \rho \cdot v^2$$

Cw=0.47,

A=π*r^2, ρ=1.29kg/m^3,



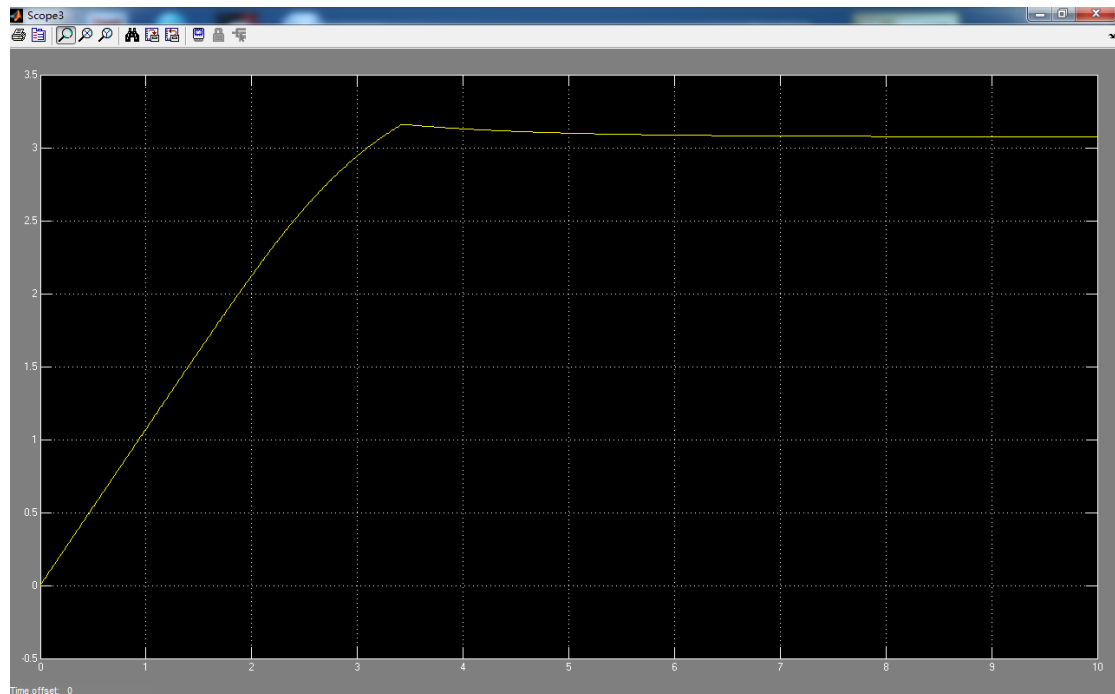
The result

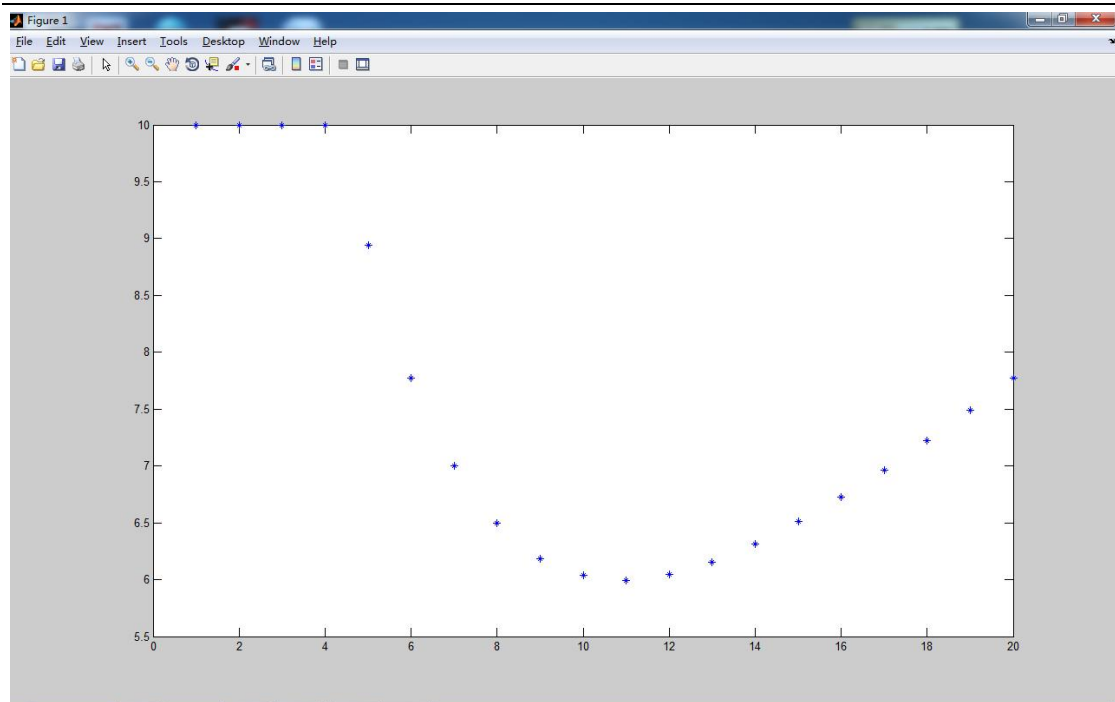
Displacement:



From this diagram,we can see that when the displacement is 14meters. The time is nearly 5.8 seconds.

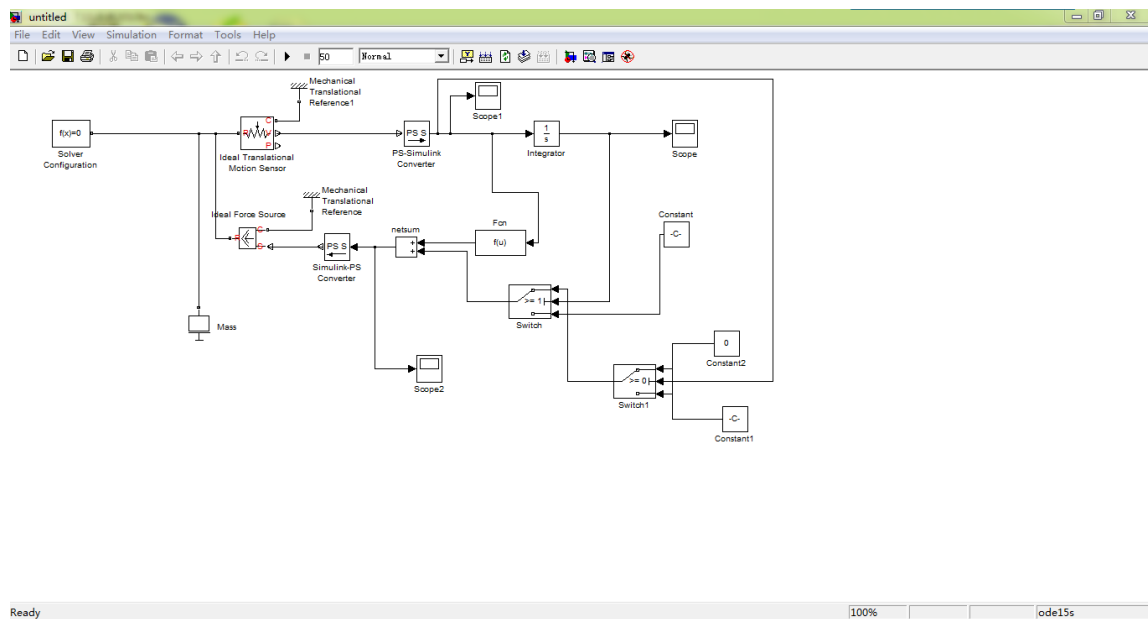
Velocity:





Through this , we can see that the time is the smallest when the gear ratio is 11. So after that we will select this gear ratio, when we made the gear box.

Part 2-simulink 2



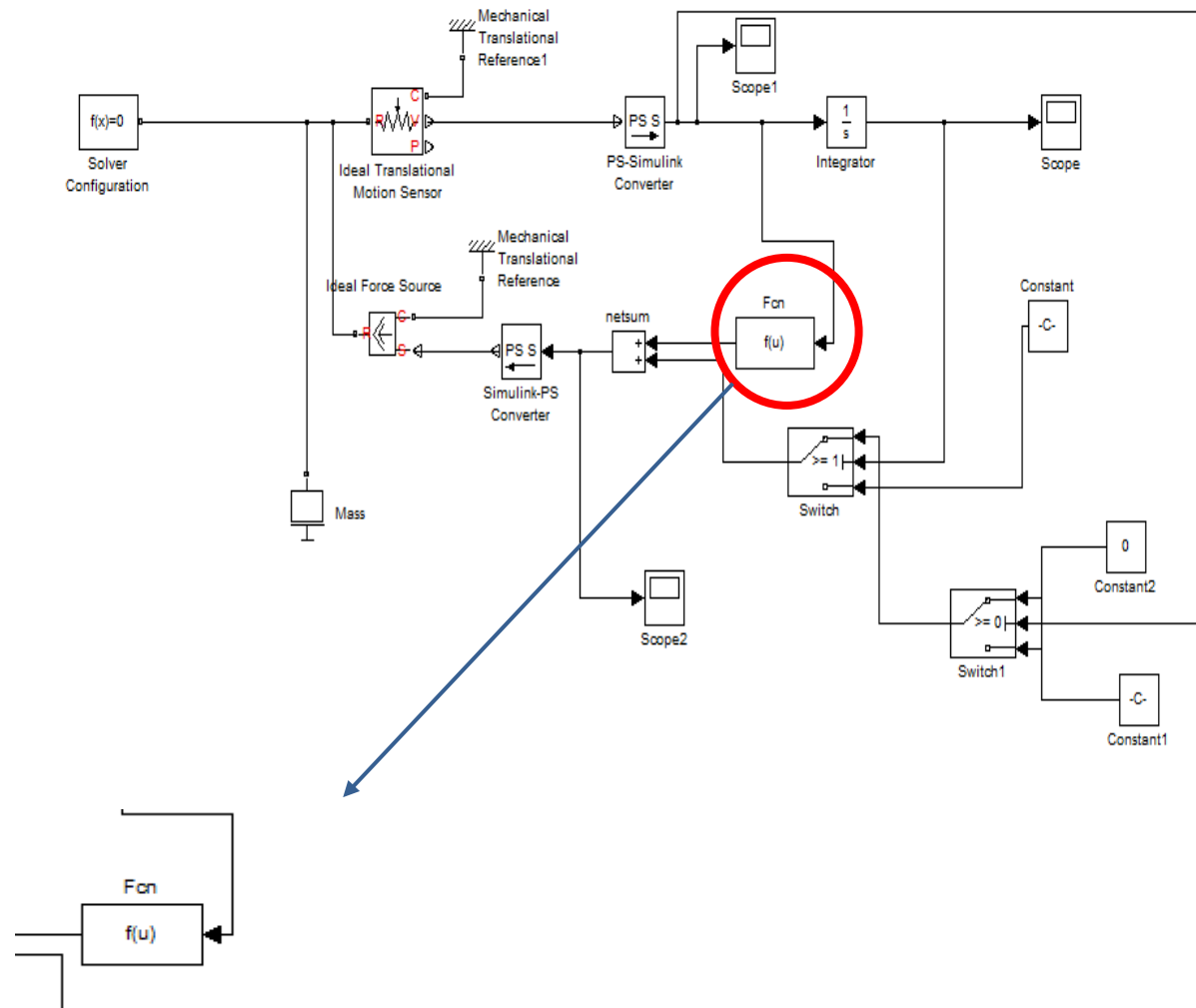
simulink2--structure i

This is the structure of our simulink 2 which is to measure the distance when we make the SSV go from 1 meter up the ramp used in the race, which is the distance not the height, without any propulsion, motor and

solar panel.

Now we will explain our design.

1. Air resistance

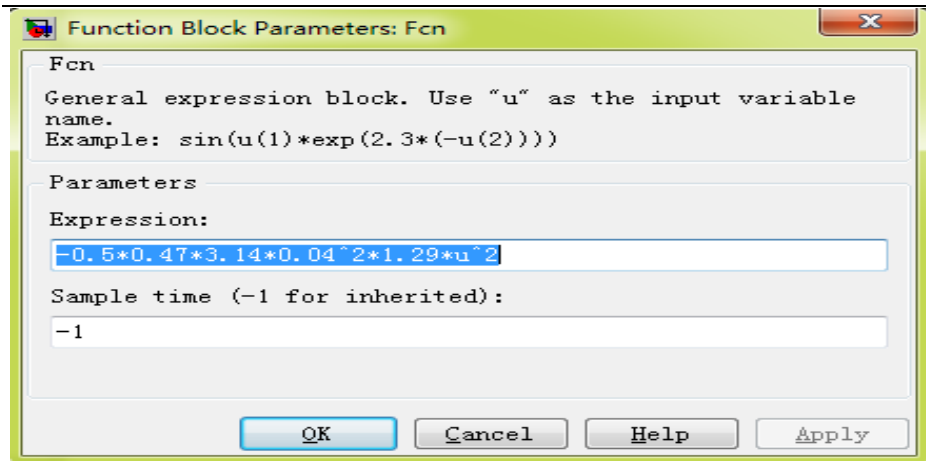


F_{cn} is the resistance which comes from air.

Air resistance (no wind):

$$F_w = \frac{1}{2} \cdot C_w \cdot A \cdot \rho \cdot v^2$$

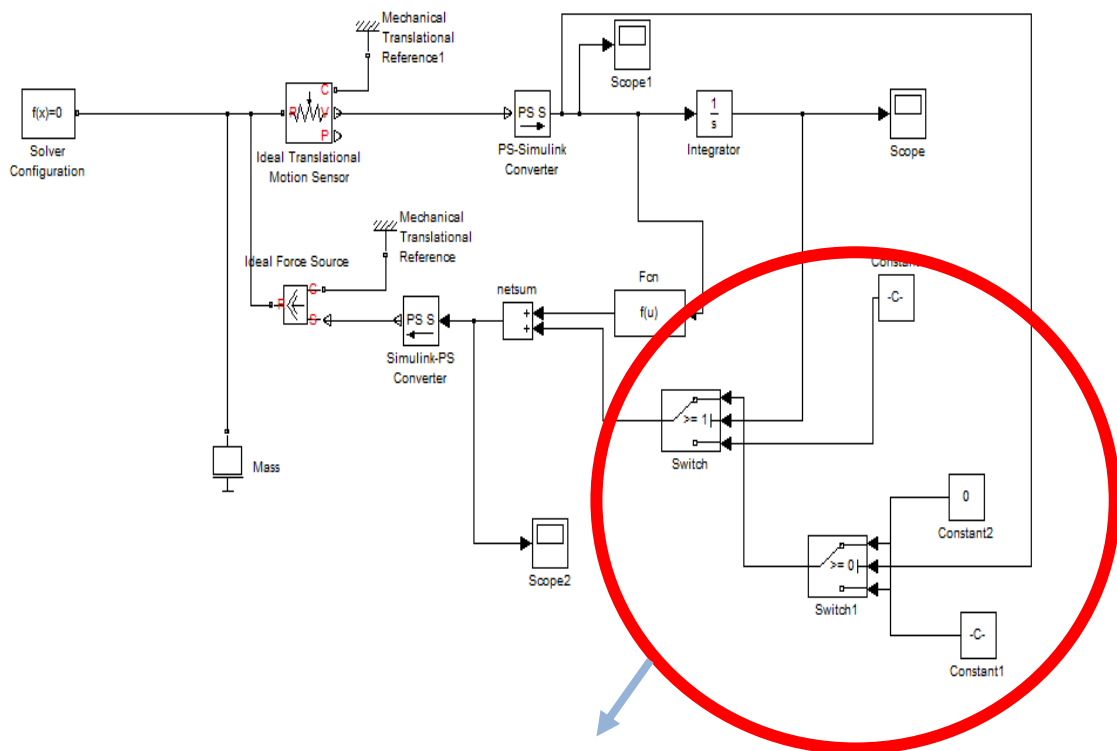
This is the function to calculate the air resistance.

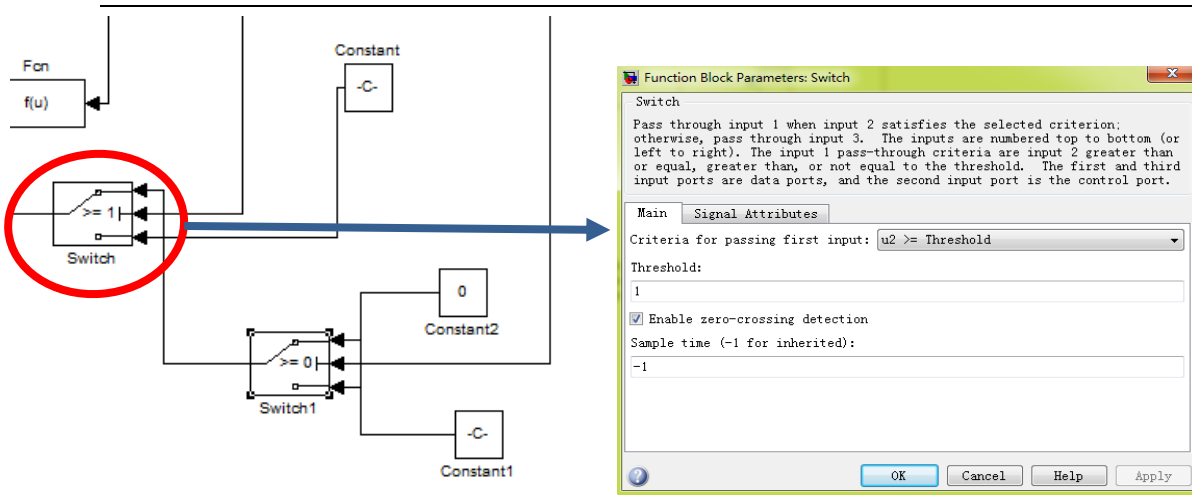


In our function of F_{cn} ,

$$C_w=0.47; \quad A=3.14*0.04^2; \quad \rho = 1.29$$

2. Ramp

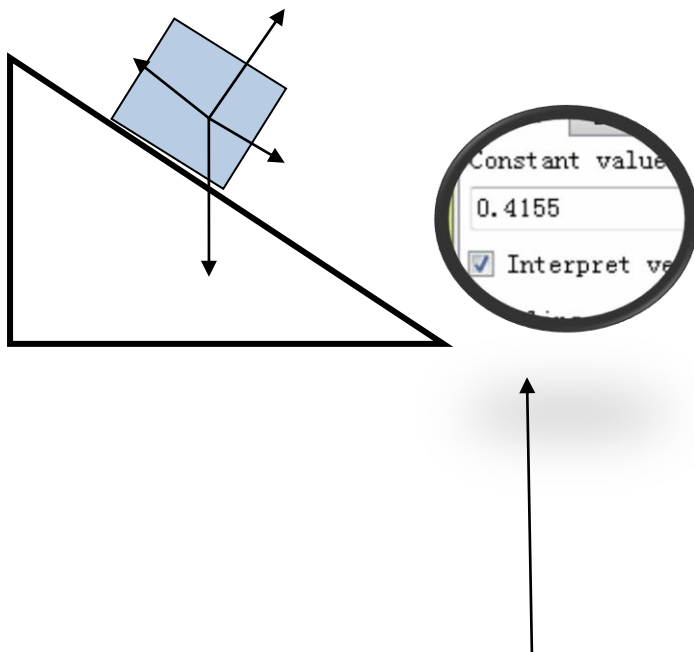


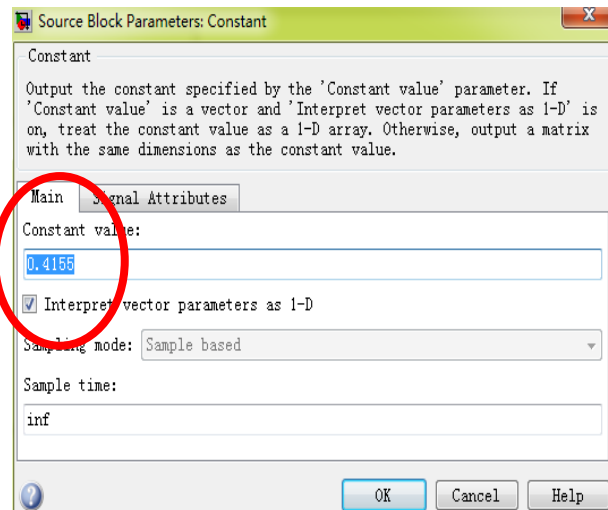


This switch is used to control the ramp's distance. When the s(the displacement) is shorter than 1 meter(on the slope or ramp)the F the SSV get (expect the air resistance) is:

$$F = m * g * \sin\theta - C_{rr} * m * g * \cos\theta ;$$

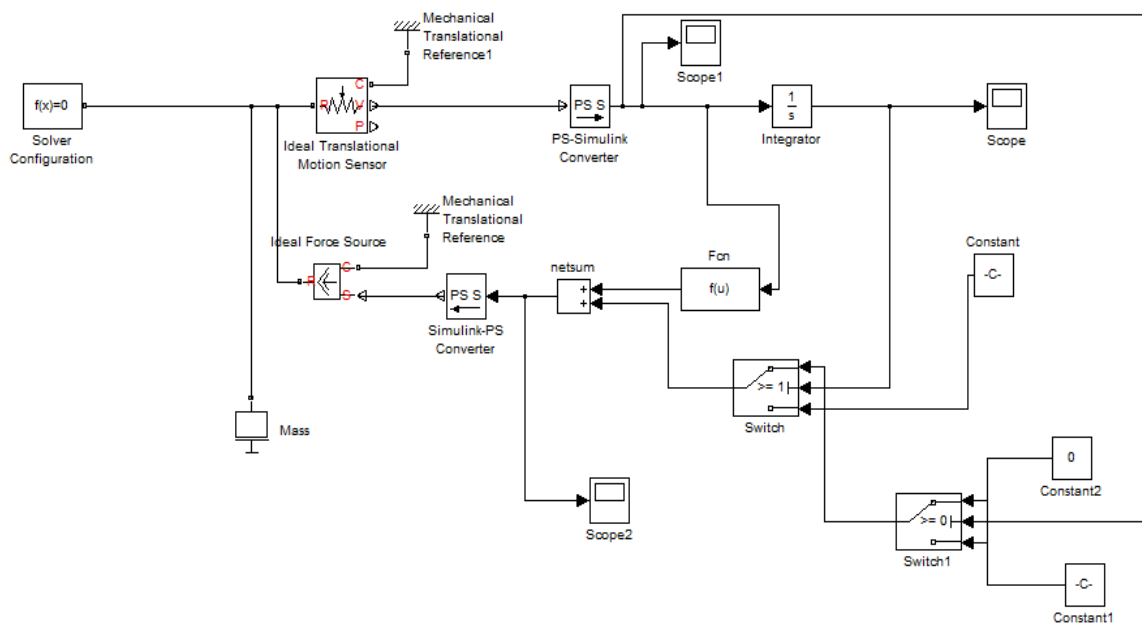
In our condition $m=1\text{kg}$; $g=9.81\text{m/s}^2$; $\theta = 3$, so we get the $F=0.4155\text{N}$

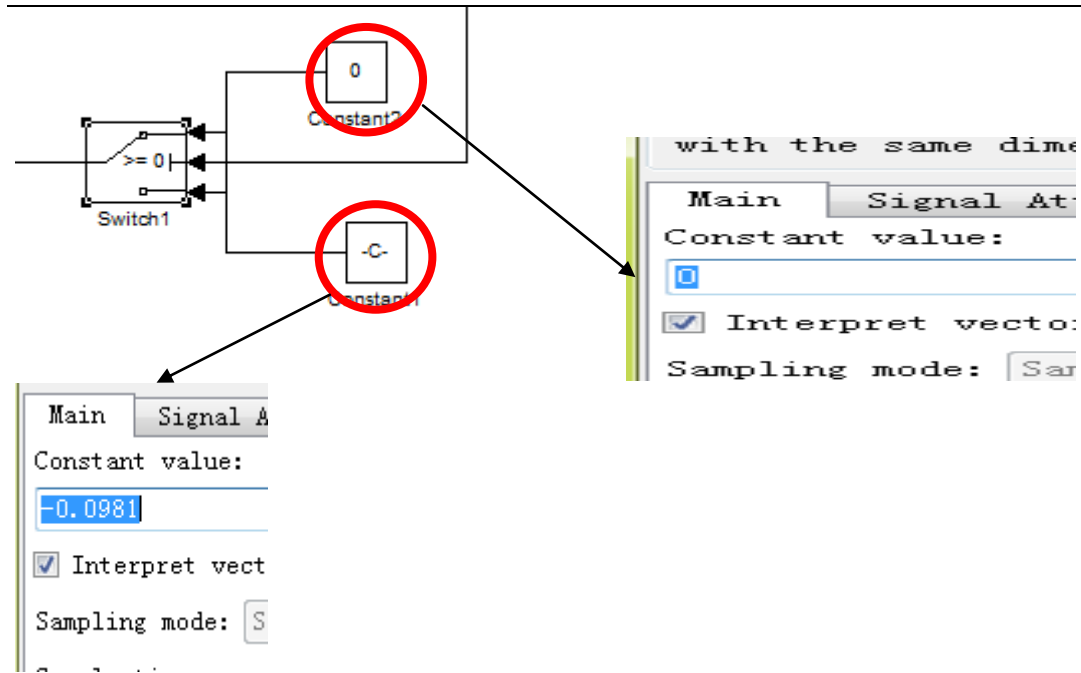




3. Velocity

We use this switch to control the velocity. Because when our SSV gets on the flat, the SSV only gets the resistance when the $V > 0 \text{ m/s}$. So we use the switch to change the force to 0N when the $V < 0 \text{ m/s}$.





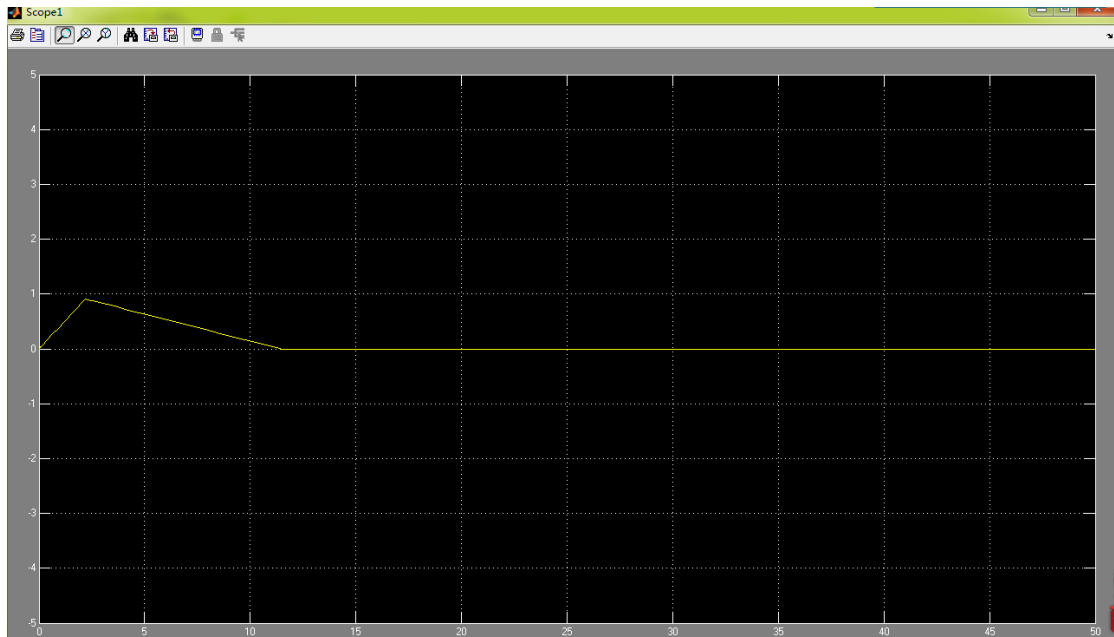
4. The result of our simulink

1) The s(displacement)



In this diagram, we can get the displacement increases from 0 when $t=0s$, and stops at 5.2m when $t=11.5s$.

2) The v(velocity)



We find that the velocity is increasing from 0m/s to 0.9m/s,during the t from 0s to 2.2s,because of the gravity. And then is decreasing from 0.9m/s to 0m/s,during the t form 2.2s to 11.4s because of the resistance.

3) The F(force)



The force is 0.4155N during t=0s to t=2.2s, and then it changes to

0.0981N(the Fcn is so small) from $t=2.2s$ till $t=11.4s$.