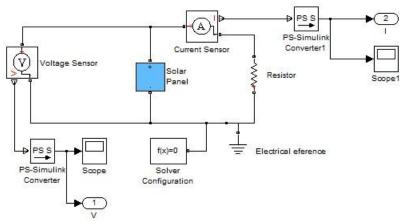
SIMULINK REPORT Part 1



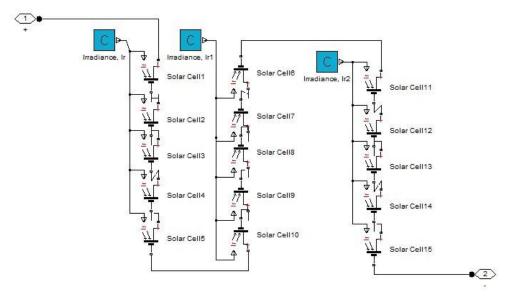
Team member: Liu Enen Lian Hao Xue Kang Yu Yang Zhang Jianyuan Chen Shu

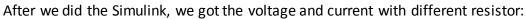
Simulink 1:

Simulate the behavior of the solar panel connected to a resistance between 10 Ohm and 100 Ohm with steps of 10 Ohm.



The inside of the solar panel:



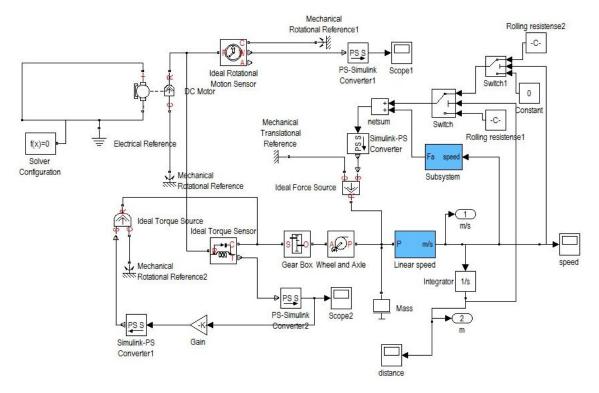


R	Ι	U	Power		
10	0.8041	8.413	6.764893	9 -	U-I
20	0.4366	8.7319	3.812348		
30	0.2947	8.8405	2.605295	8.8 -	
40	0.2222	8.8862	1.974514		
50	0.1782	8.9115	1.588029	8.6 -	
60	0.1488	8.9275	1.328412		
70	0.1277	8.9387	1.141472	8.4 -	•
80	0.1118	8.9468	1.000252		
90	0.0995	8.9531	0.890833	8.2 -	1
100	0.0896	8.958	0.802637		0 0.5 1

When R=10 Ω , the power P=6.764893W is the maximal power transfer.

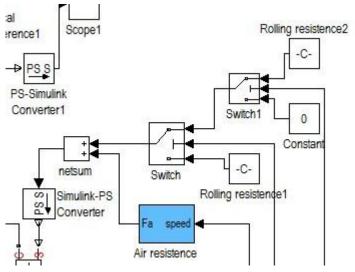
SIMULINK 2

Simulate the behavior of your vehicle with DC-motor, but without solar panel. Extend the model with the different load torques



This is the situation the SSV with DC-motor, without solar panel, starts at a height of 0.25 m and rolls down for a distance of 2 m.

There are two processes with different resistance from the SSV rolling down to stop, so we use a switch to separate these two processes.



First process is the SSV rolls down for 2m. At this situation the rolling resistance1 is -Crr*mass*9.81*cos θ +mass*9.81*sin θ

Constant		
'Constant on, treat	value' is a vector a	by the 'Constant value' parameter. If and 'Interpret vector parameters as 1-D' is as a 1-D array. Otherwise, output a matrix se constant value.
Main Si	gnal Attributes	
Constant va	lue:	
-Crr*mass*	9.81*0.992+mass*9.81	*0. 125
Interpresentation	t vector parameters	as 1-D
Sampling me	de: Sample based	÷
Sample time	:	
inf		
0		
		OK Cancel Help

After 2m the rolling resistance2 will be -Crr*mass*9.81, until the velocity equals to 0.

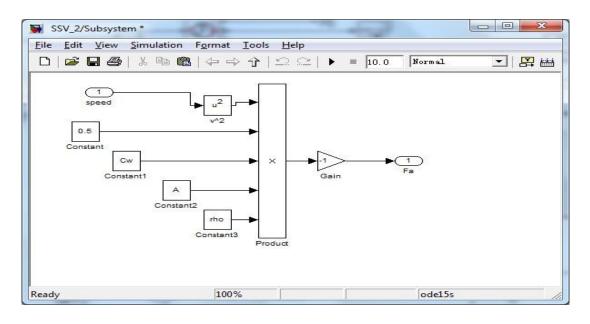
'Constant valu on, treat the	e' is a vector and '	the 'Constant value' parameter. If 'Interpret vector parameters as 1-D' is 1-D array. Otherwise, output a matrix
	Attributes	Sistant value.
Constant value	5	
-Crr*mass*9.81		
🚺 Interpret v	ector parameters as	1-D
Sampling mode:	Sample based	
Sample time:		
inf		

When the velocity becomes 0, the rolling resistance will be 0 also. And that's why we use another switch "switch1".

For "switch", if the distance is larger than 2m, the switch will choose "switch1";

For "switch1", if the velocity =0, the switch will choose constant 0. And the SSV will stop, we can get the largest distance.

This is the subsystem of air resistance. Fw = $\frac{1}{2} \cdot Cw \cdot A \cdot \rho \cdot v^2$



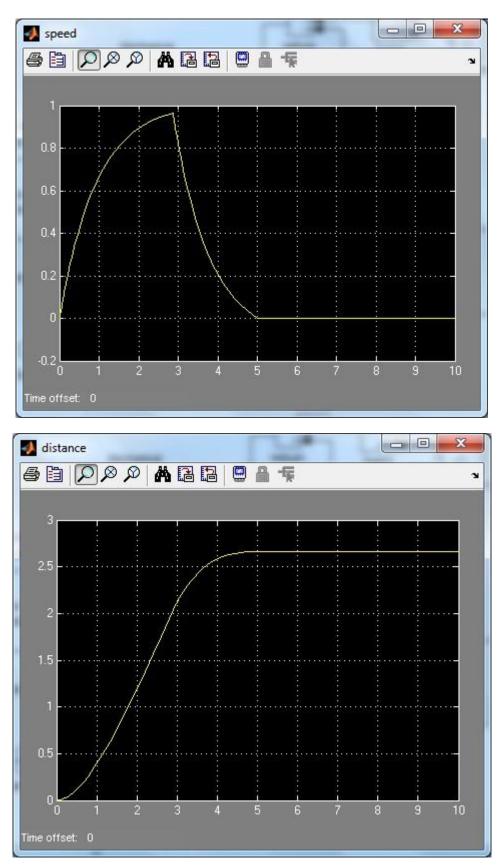
```
%%% Motor parameters
Ra = 3.32; % ohm
```

Km = 0.00855; % Nm/A La = 2.2e-4; % H Im = 4.1; % g*cm^2 Cm = 0e-4; % N*m/(rad/s) %%% SSV parameter mass = 1; % kg Cw = 0.5; A = 0.02; % m^2 rho = 1.29; % kg/m^3 Crr = 0.012; %%% Wheel radius r = 0.035; % m

	Function Block Parameters: Gain
	Gain Element-wise gain (y = K.*u) or matrix gain (y = K*u or y = u*K).
	Main Signal Attributes Parameter Attributes
Ideal Torque Seurce	Gain: TO.05 Multiplication: Element-wise(K.*u) Sample time (-1 for inherited): -1
Gear Box Wheel and Axle Rotational Reference2 PS-Simulink Scope2 Simulink-PS Gain Converter1	OK Cancel Heip Apply

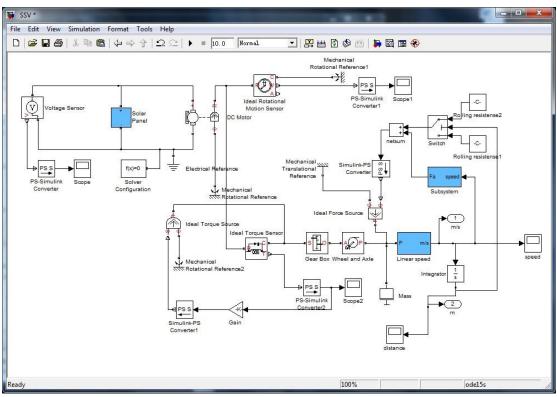
With a certain load torque we get the result below





the total distance we can get from the figure is 2.67m.

SIMULINK 3



We keep most part of the Simulink 2, only add a solar panel, and change the rolling resistance.

During the race, for the first 10m the rolling resistance1 is

Constant	
'Constant value' on, treat the cor	nt specified by the 'Constant value' parameter. If is a vector and 'Interpret vector parameters as 1-D' i stant value as a 1-D array. Otherwise, output a matrix ensions as the constant value.
Main Signal A	tributes
Constant value:	
-Crr*mass*9.81	
🗸 Interpret vect	or parameters as 1-D
Sampling mode: Sampling mode:	mple based
Sampling mode: Sample time:	mple based
C C CO	mple based
Sample time:	mple based

For the last 4m the rolling resistance changes to -Crr*mass*9.81*cos θ -mass*9.81*sin θ

inf

0

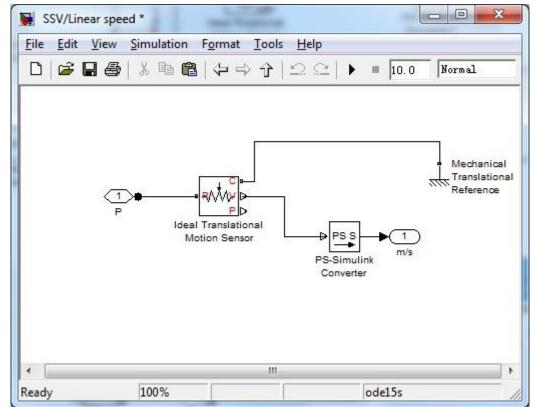
Constant	
'Constant value' is a vecto	ed by the 'Constant value' parameter. If r and 'Interpret vector parameters as 1-D' is e as a 1-D array. Otherwise, output a matrix the constant value.
Main Signal Attributes	
Constant value:	
-Crr*mass*9.81*0.99-mass*9.	81*0. 125
Interpret vector paramete	ers as 1-D
Sampling mode: Sample based	

OK

Cancel

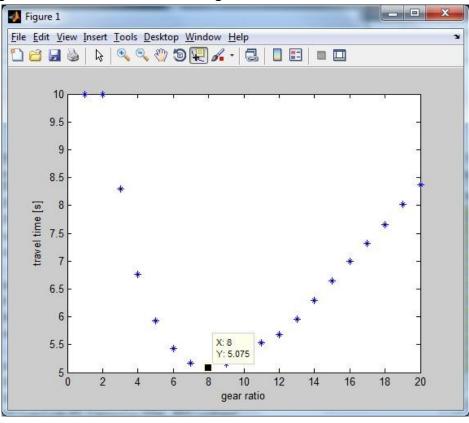
<u>H</u>elp

The subsystem of the linear speed



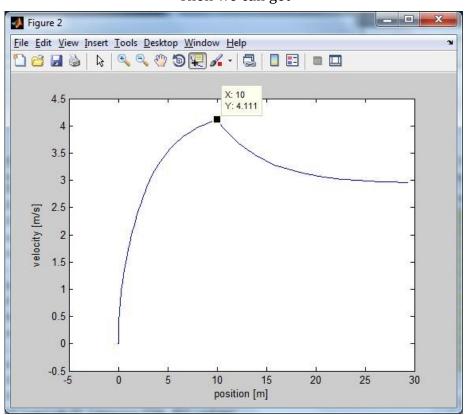
The code in script

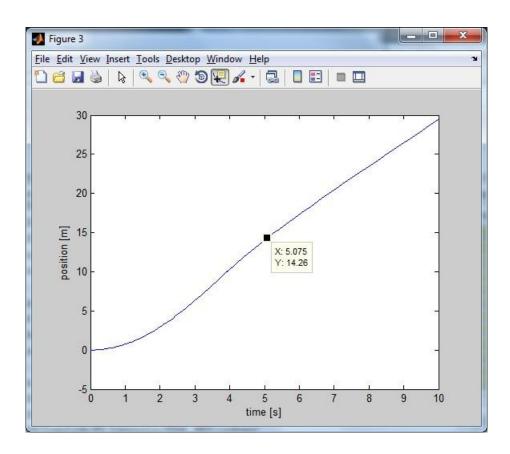
🖻 Edite	or - D:\Study\EE4\Matlab\New folder\SSV_script.m
<u>F</u> ile	Edit <u>T</u> ext <u>G</u> o <u>C</u> ell T <u>o</u> ols De <u>b</u> ug <u>D</u> esktop <u>W</u> indow <u>H</u> elp
: 1) 6	🖥 📓 👗 🐂 🛱 🤊 🕐 🔤 🚽 🚧 🖛 🜩 ft: 🔛 - 🛃 🖓 👘 🗊 🕼 🍓 Stack: Base
: +🖷 📢	
1	%%% Solar Power
2 -	<pre>Ir = 800 ; % solar irradiance [W/m^2]</pre>
3 -	<pre>Is = 1e-8; % saturation current [A]</pre>
4 -	<pre>Isc = 0.88: % short circuit current [A]</pre>
5 -	Voc = 0.6; % Open circuit voltage [V]
6 - 7 -	<pre>Ir0 = 800; % irradiance used for measurements [W/m^2] m = 1.015; % diode quality factor</pre>
8	%%% Motor parameters
9 -	Ra = 3.32; % ohm
10 -	Km = 0.00855; % Nm/A
11 -	La = 2.2e-4; % H
12 -	Im = 4.1; % g*cm ²
13 -	Cm = 0e-4; % N*m/(rad/s)
14 15 -	%%% SSV parameter
16 -	mass = 1; % kg Cw = 0.5;
17 -	$A = 0.02; \% m^2$
18 -	rho = 1.29; % kg/m ³
19 -	Crr = 0.012:
20	%%% Wheel radius
21 -	r = 0.035; % m
22 23	%%% Irack
24 -	% put parameters track here % result=[]:
25 -	tn=[]:
26 -	🖵 for ratio=1:20
27 -	ratio
28 -	<pre>tn=[tn ratio]: % Extend vector with current ratio</pre>
29 -	<pre>sim('SSV',10): % Simulate Simulink model for 10 s</pre>
30 -	<pre>[i, j]=find(yout(:, 2)>14); % find when position of 14 m is achieved if incontra(i)</pre>
31 - 32 -	<pre>if isempty(i) result = [result 10]; % if not achieved take time = 10 s</pre>
33 -	else
34 -	<pre>result = [result tout(i(1))]; % put travel time in vector</pre>
35 -	end
36	
37 -	L end
38 - 39 -	figure(1) plot(tn,result,'*') % plot gear ratio versus travel time
40 -	plot(th, result, *) % plot gear ratio versus travel time xlabel('gear ratio')
41 -	ylabel('travel time [s]')
42 -	<pre>[opt,i]=min(result): % find minimal travel time</pre>
43 -	ratio=tn(i); % select gear ratio corresponding to the minimal travel time
44	% simulate once more with best gear ratio and make a few plots
45 -	sim('SSV',10):
46 -	figure(2)
47 -	plot(yout(:,2),yout(:,1)) xlabel('position [m]')
49 -	ylabel('velocity [m/s]')
50 -	figure(3)
51 -	<pre>plot(tout, yout(:, 2))</pre>
52 -	<pre>xlabel('time [s]')</pre>
53 -	<pre>ylabel('position [m]')</pre>
54	
55	



This figure shows the relation between gear ratio and travel time.

We can easily know that the travel time is shortest (5.075s) when gear ratio is 8. Then we can get





4. The Simulink is a quite easy and effective way to find the proper gear ratio. The calculation will be very complex without Simulink. And also the Simulink can give us figures we want immediately. We can understand the motion more directly by the figures.