Jet Solar Team

Case Simulink

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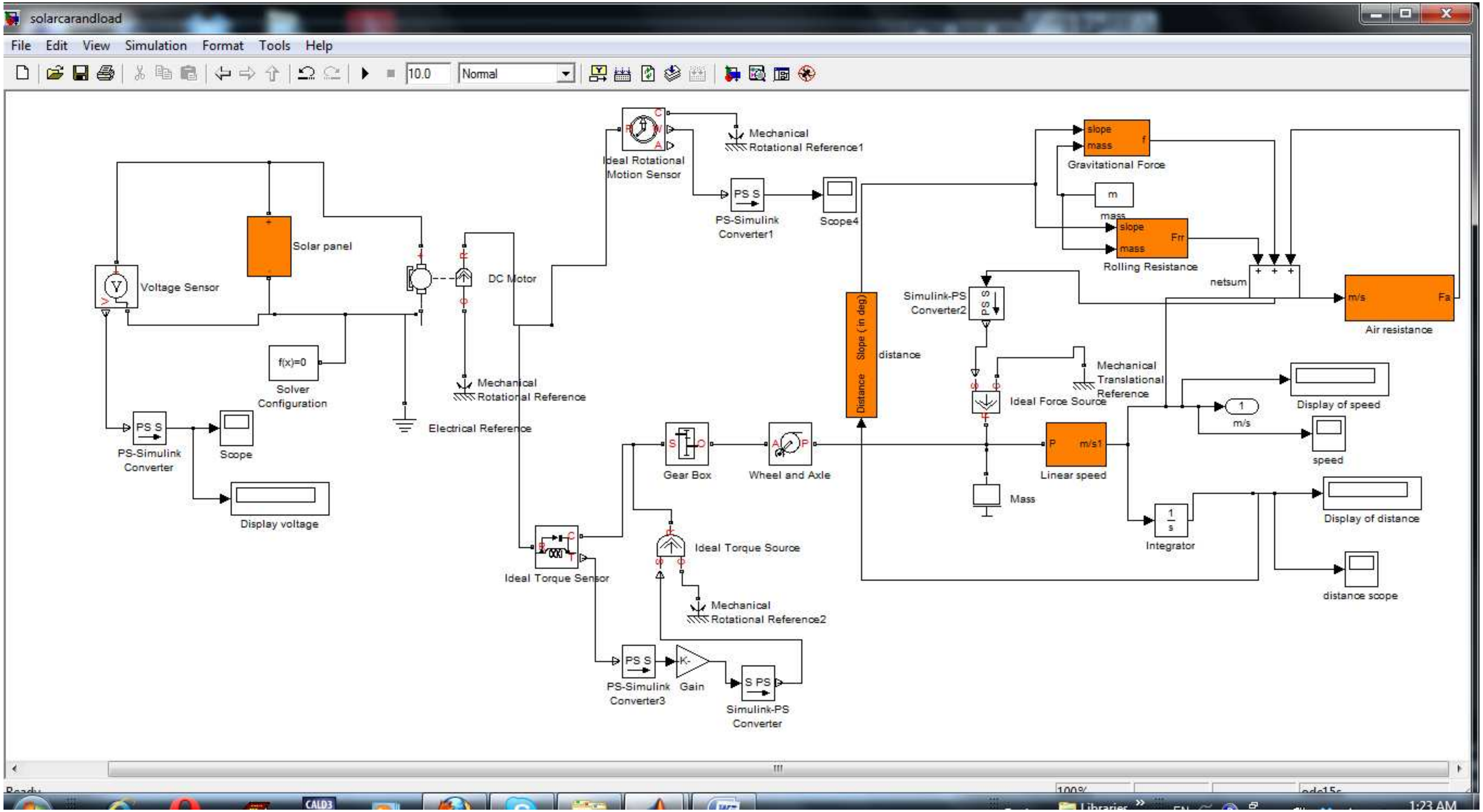
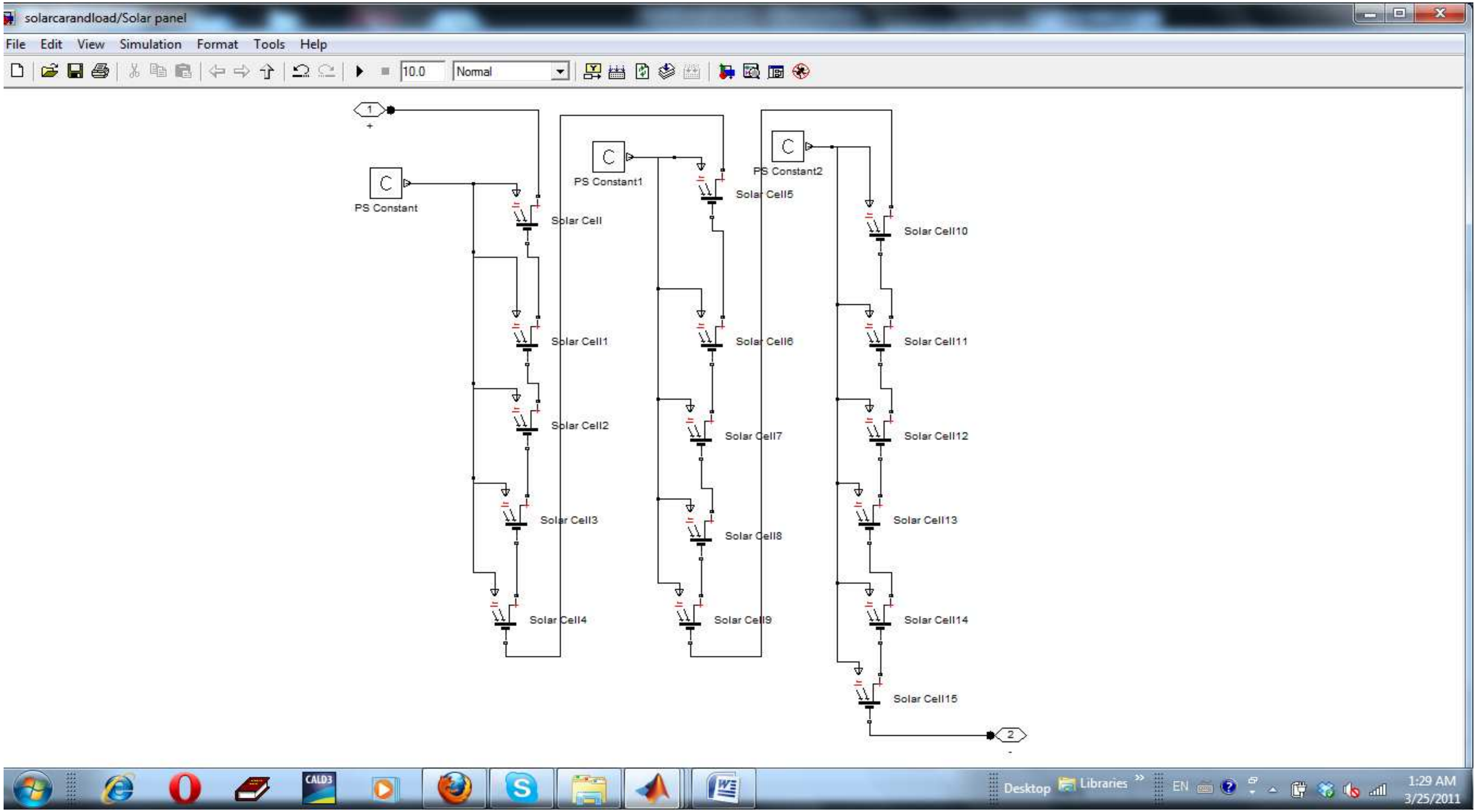
Simulink part I

Total system

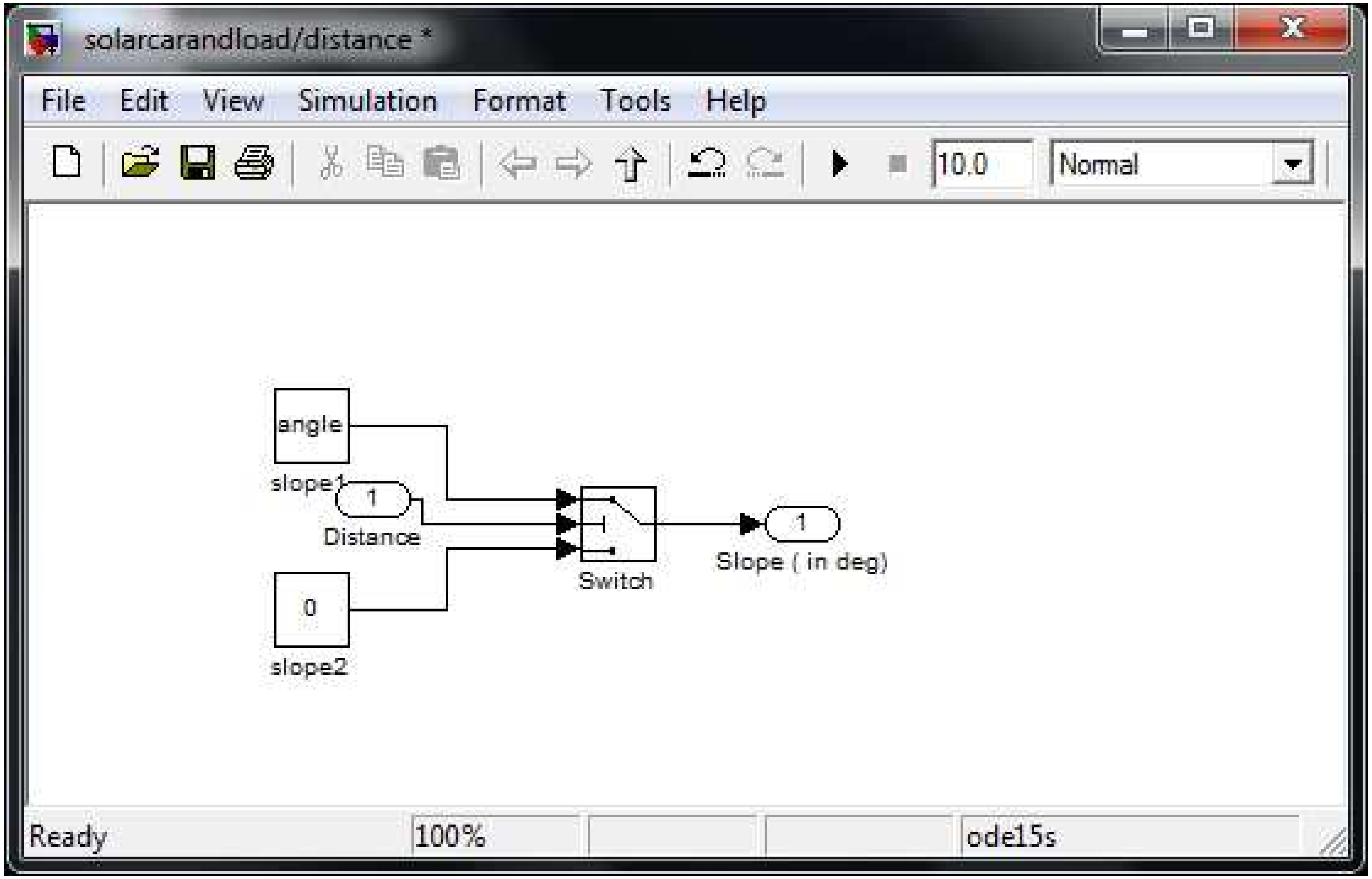


Subsystem of solar panel



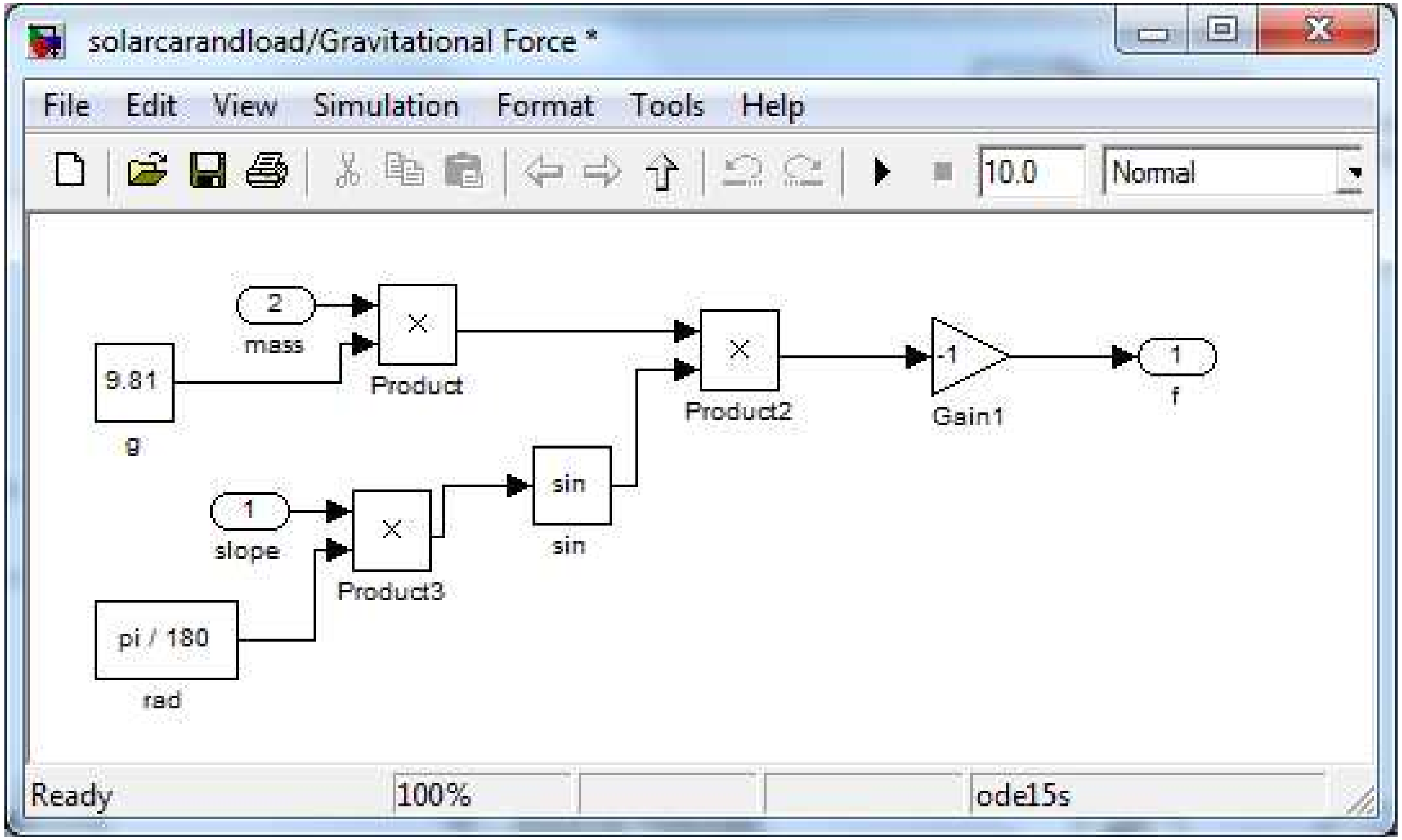
This subsystem represents the solar panel of our car.

Subsystem of distance slope



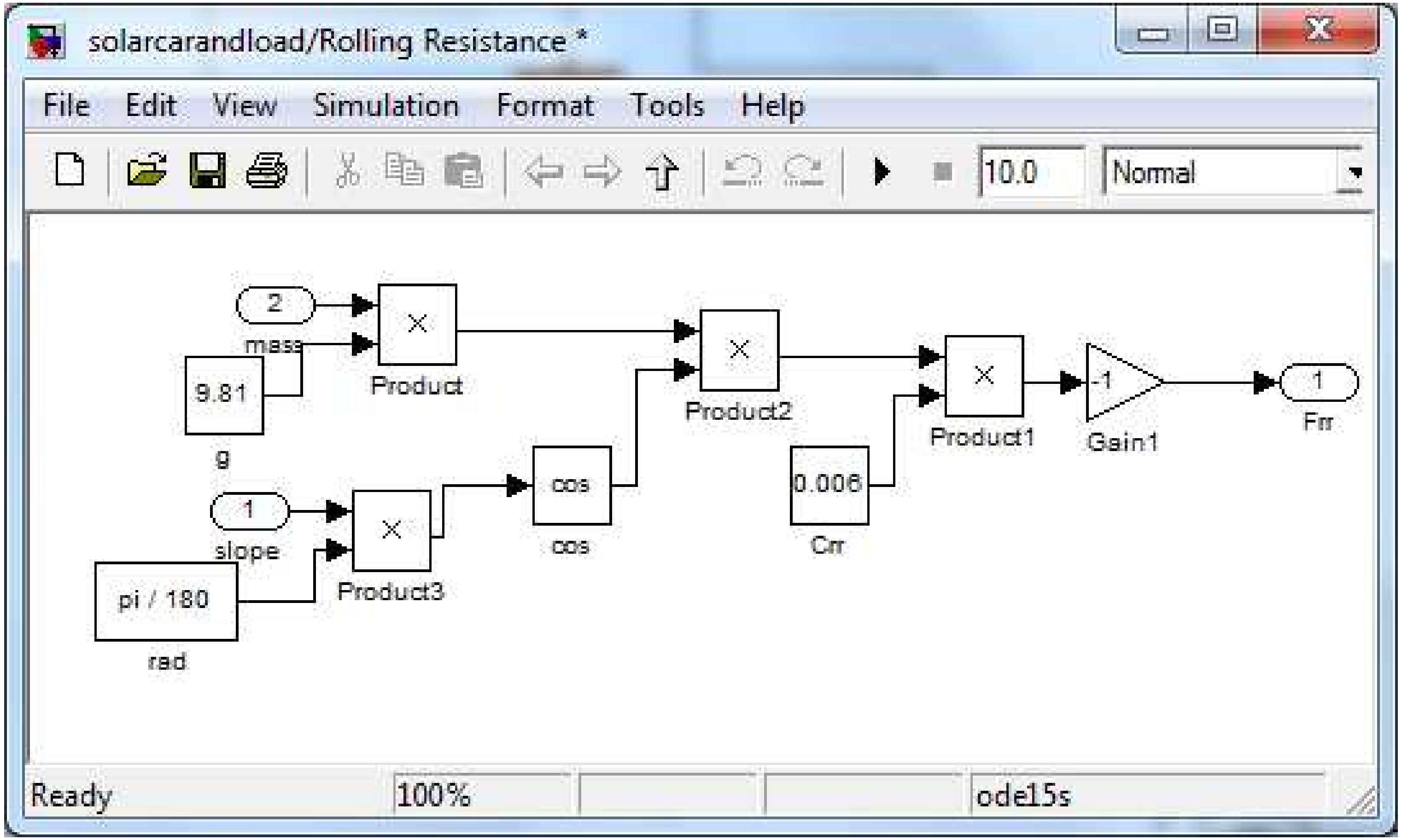
This subsystem makes it possible to switch between the flat part and the slope of the track. This is necessary because the slope has an effect on the forces that interact with the car.

Subsystem of gravitational force



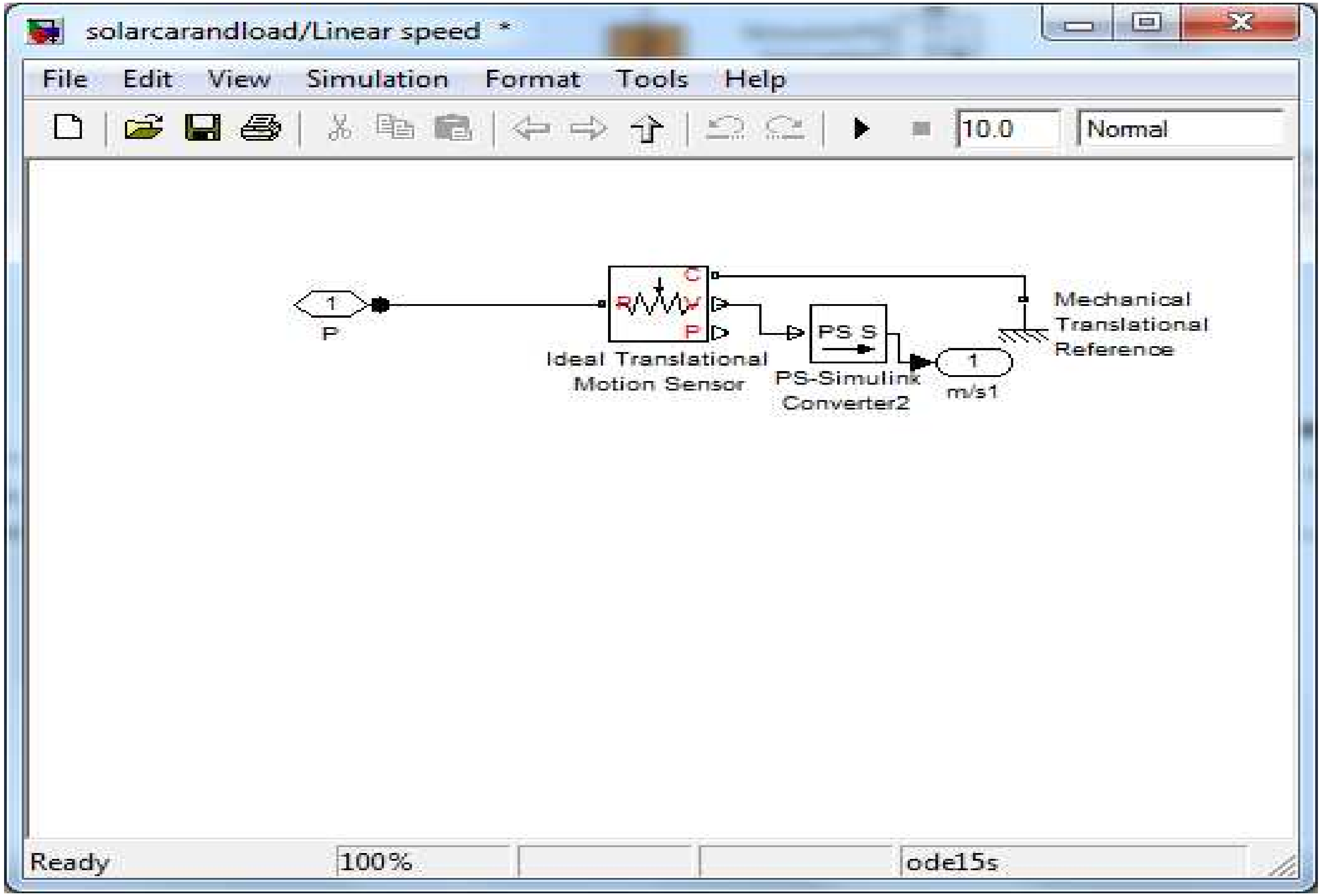
The subsystem above calculates the gravitational force working on the car.

Subsystem of rolling resistance



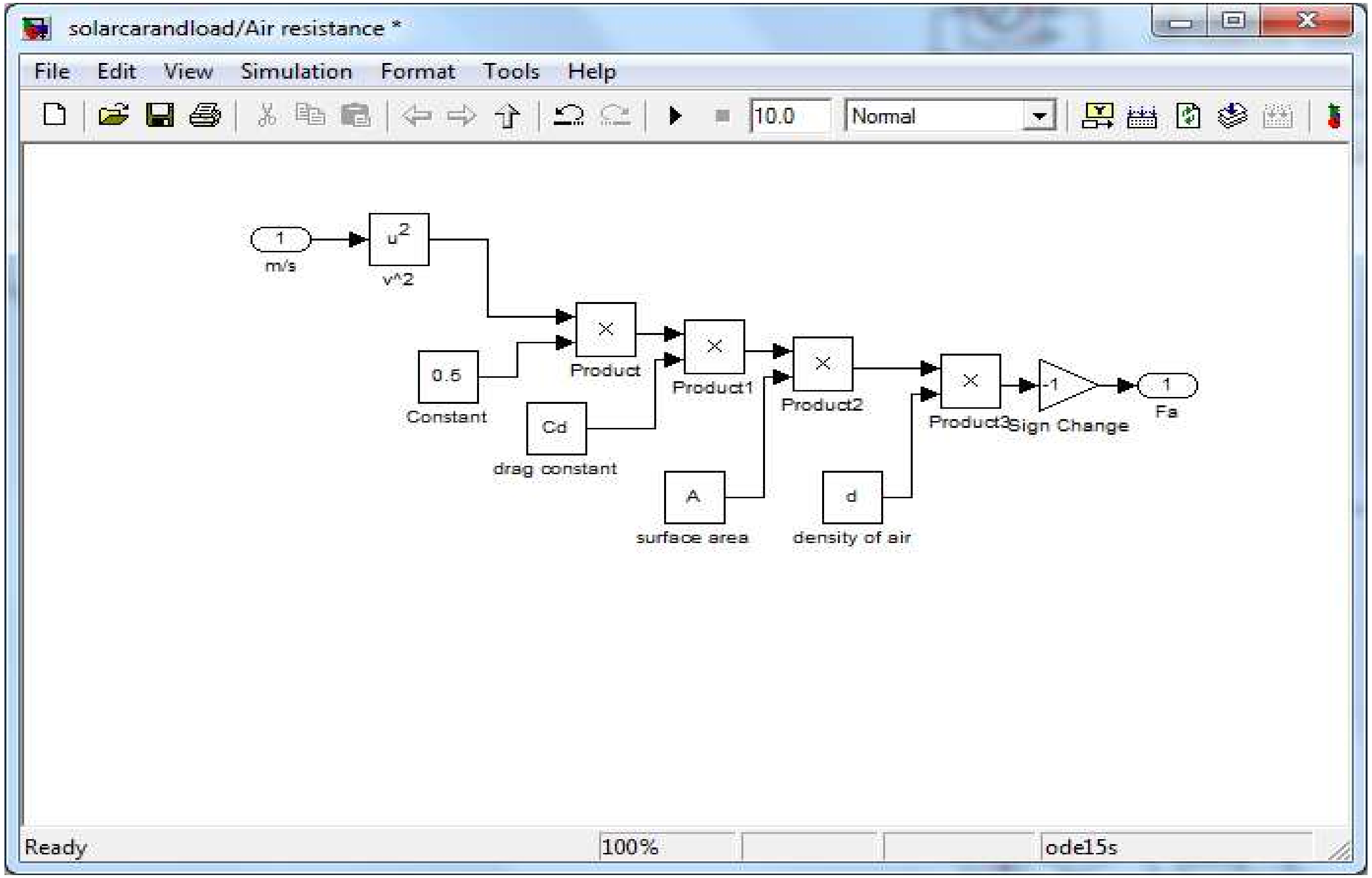
This subsystem calculates the rolling resistance that works on the car.

Subsystem of linear speed



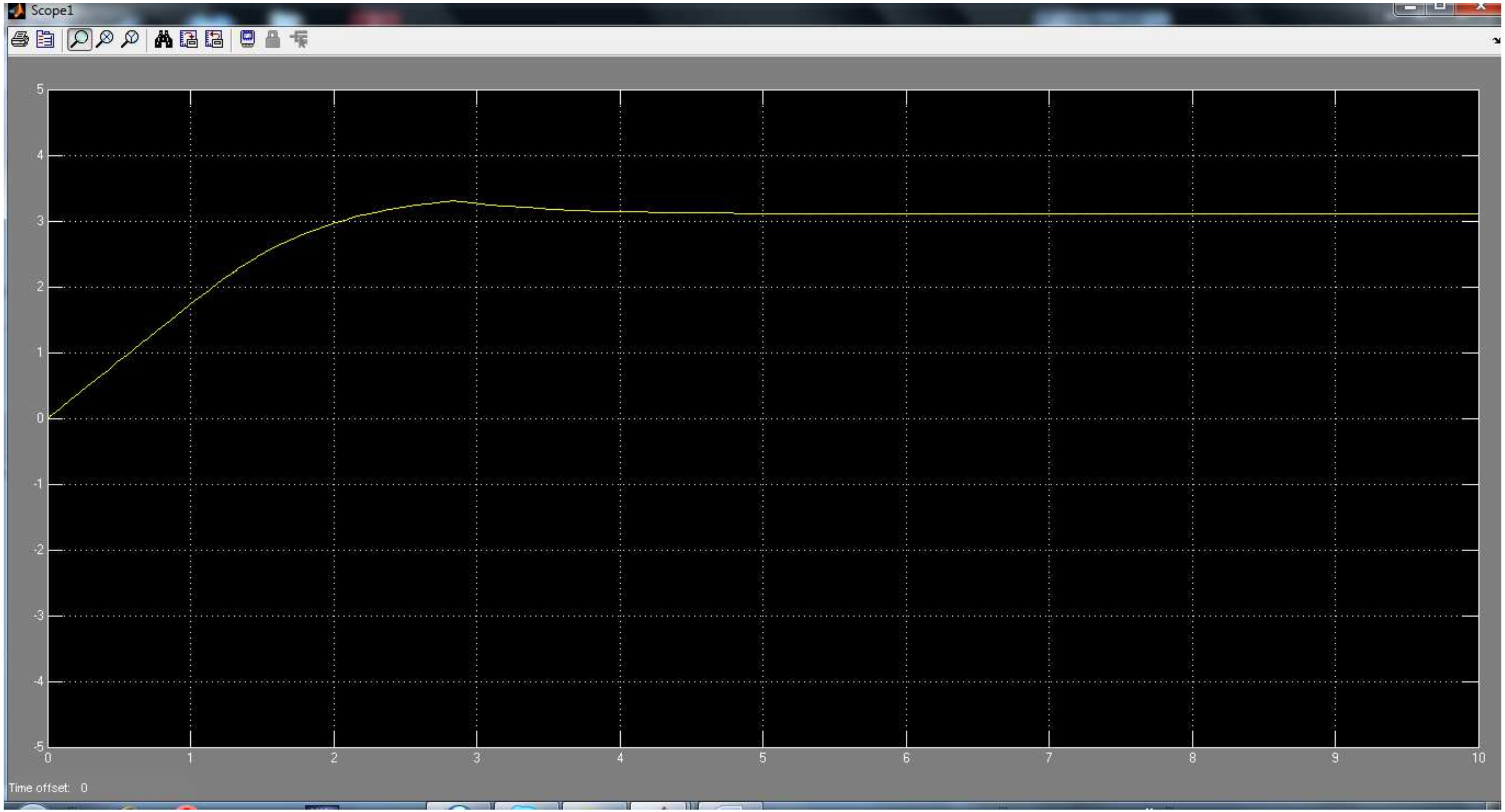
This subsystem gives us the speed of the car.

Subsystem of air resistance

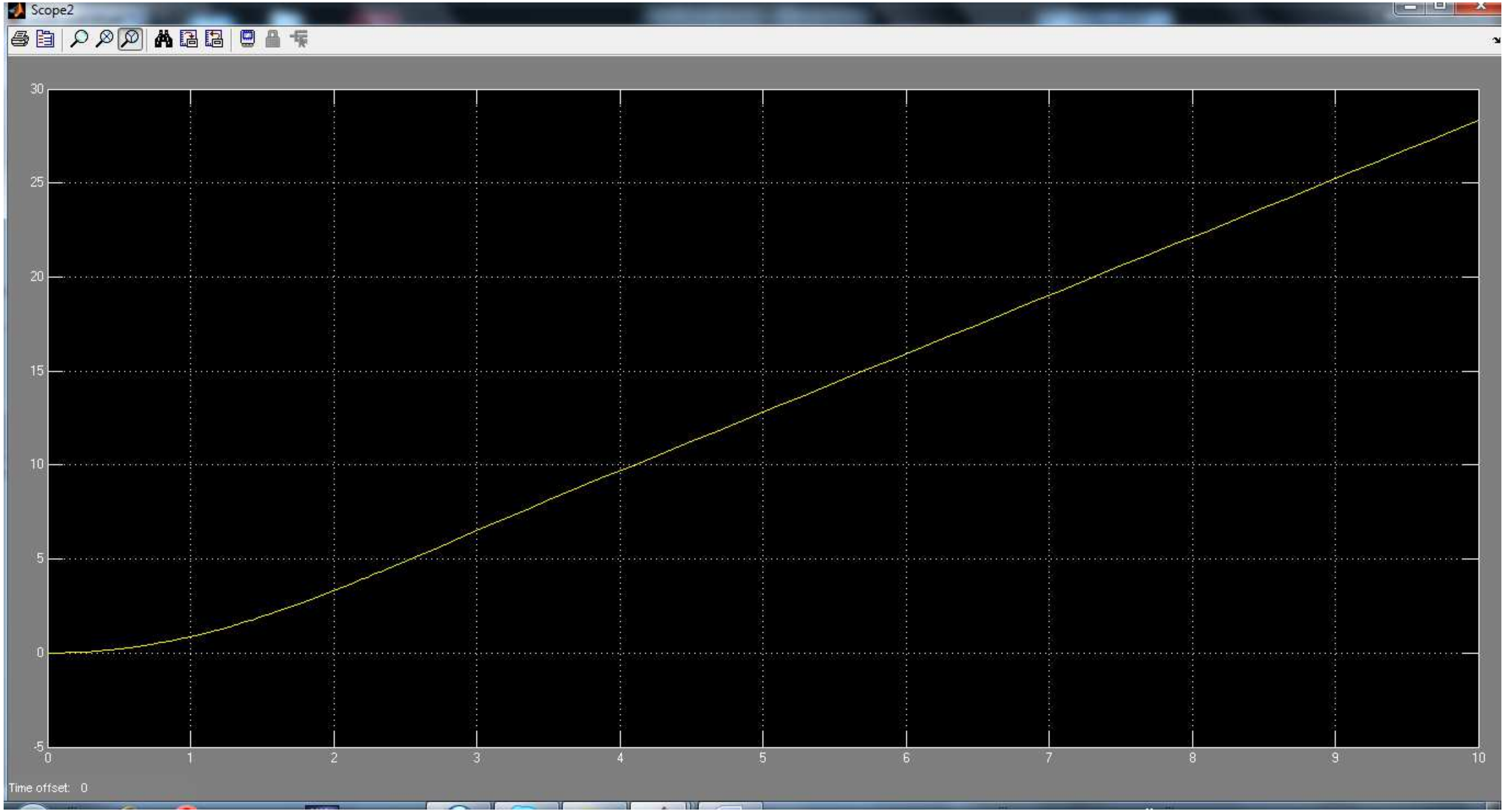


In this subsystem the air resistance is calculated.

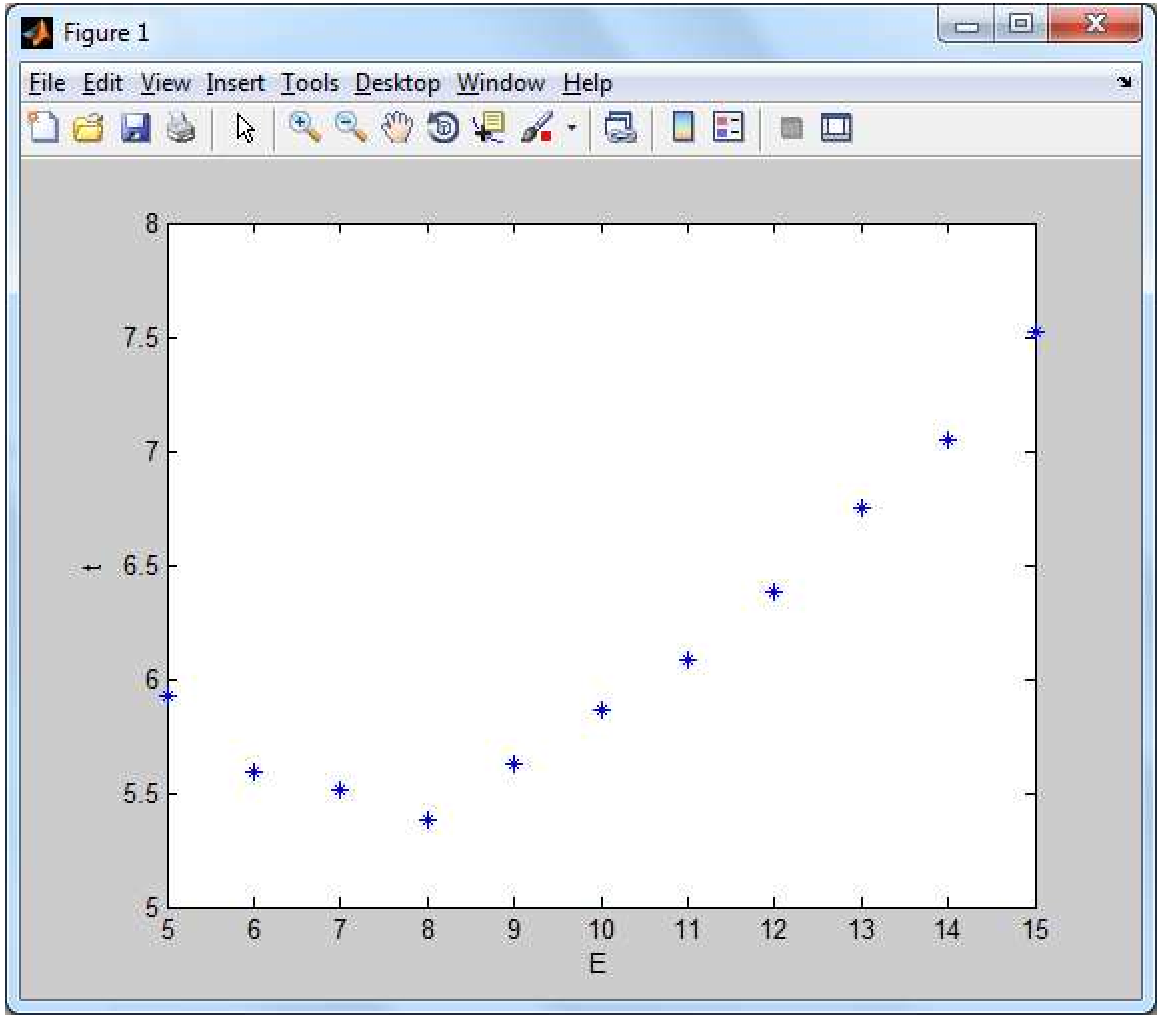
Speed graph in function of time



Distance graph in function of time

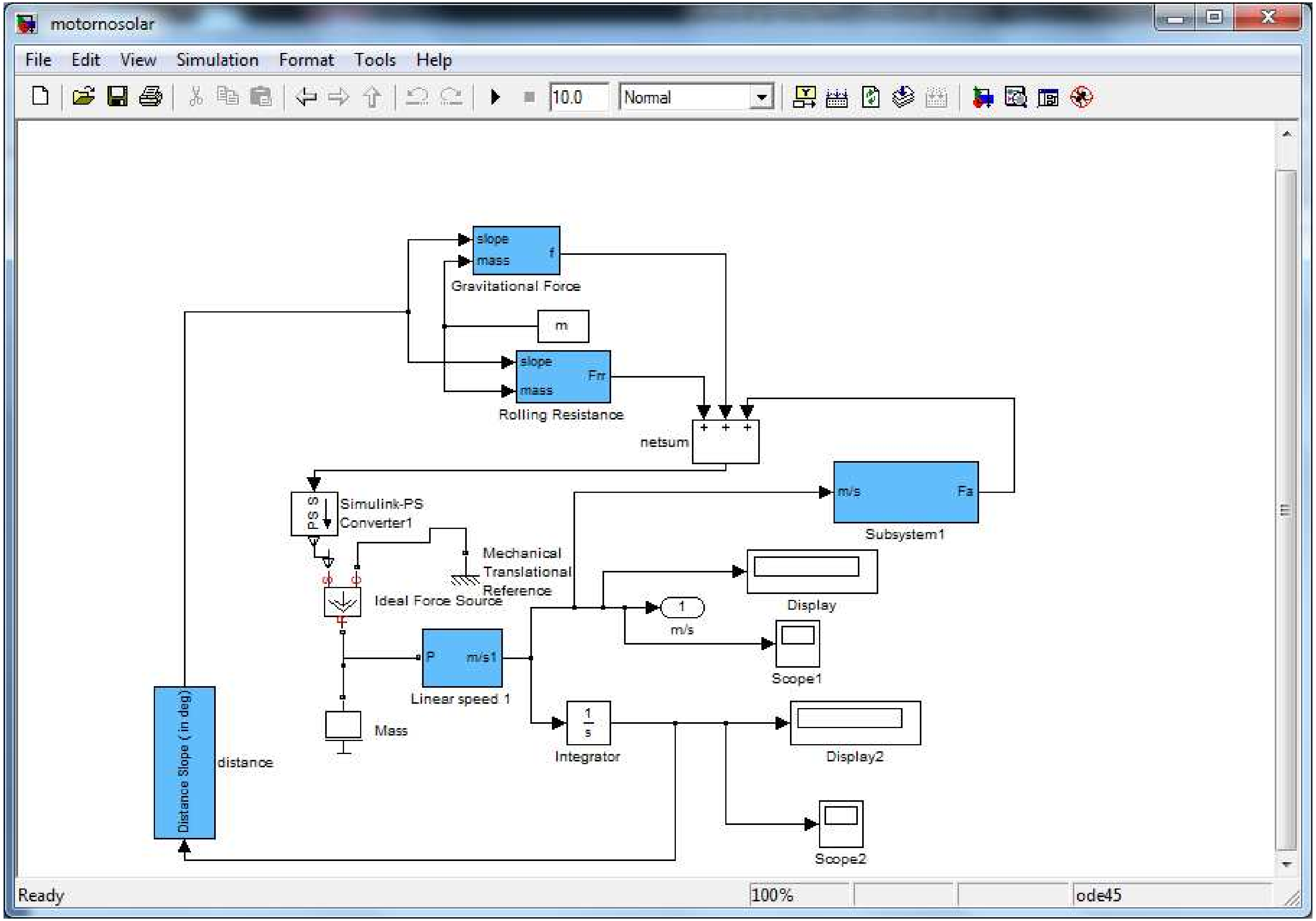


Gear ratio (E) versus travel time (t)

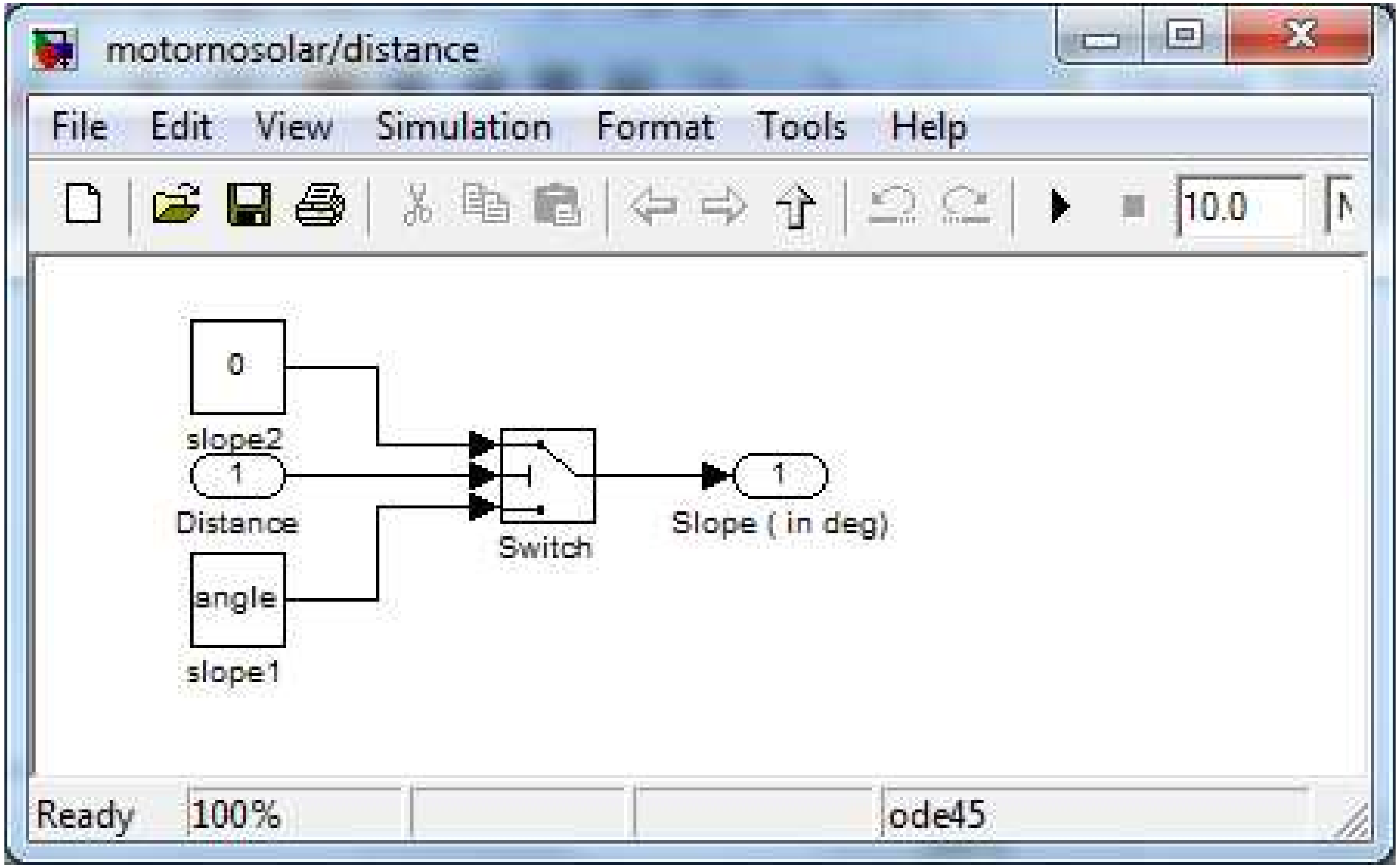


This graph shows that the best gear ratio to use for our car is 8.

Simulink part II

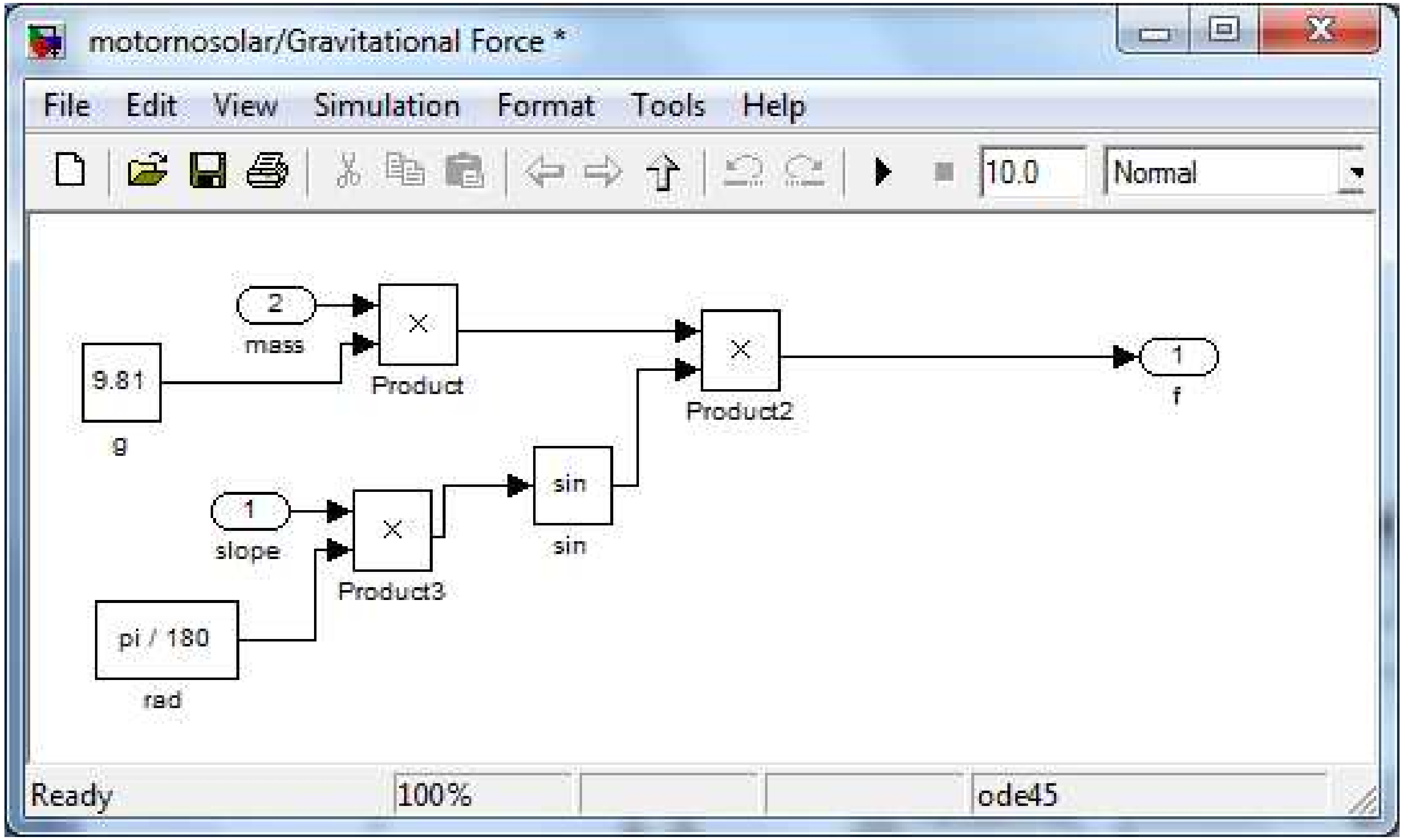


Subsystem of distance slope

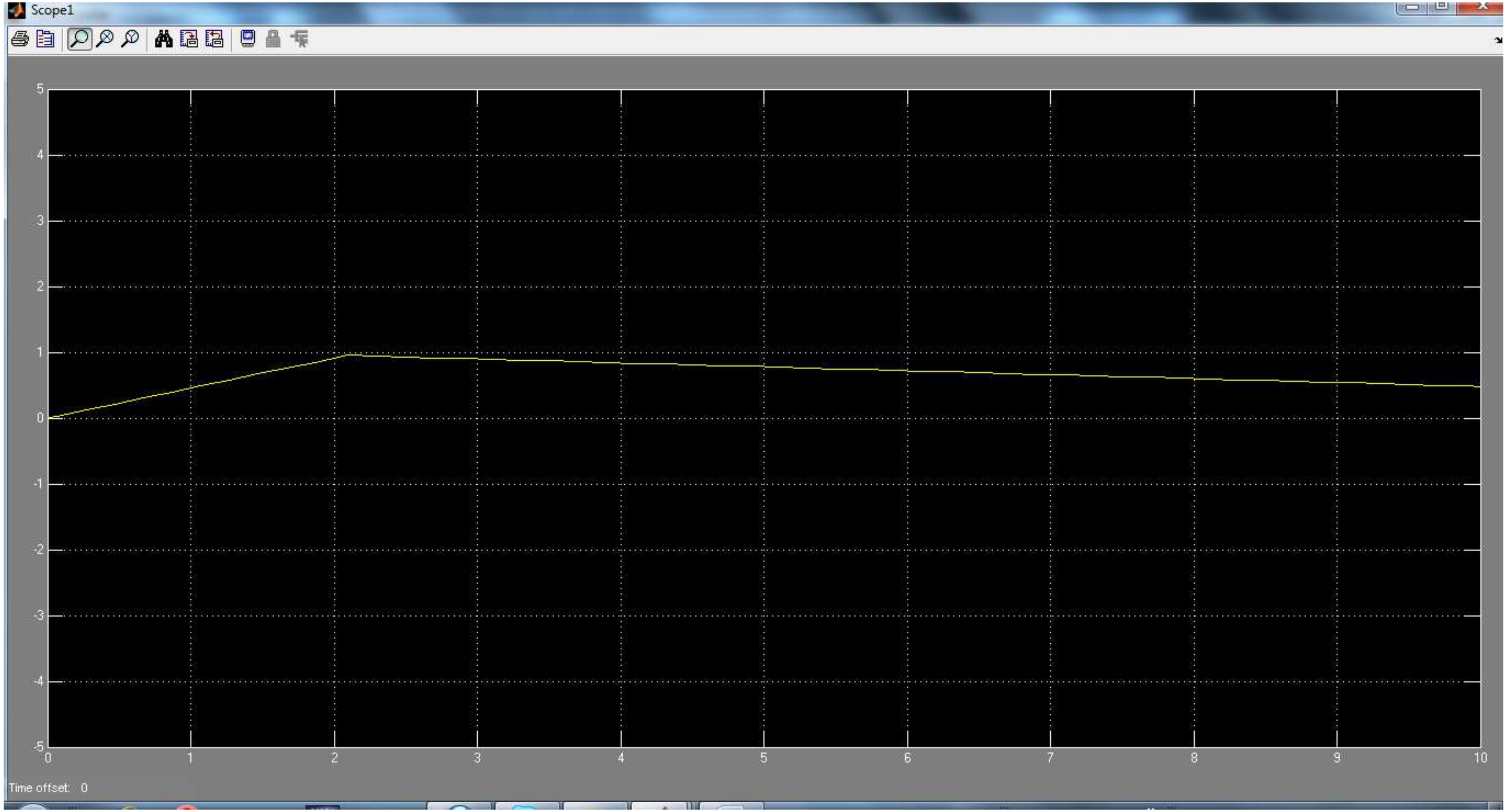


The subsystems of part II are similar to those of part I. The only difference is that these are adjusted because the car now moves in the opposite direction.

Subsystem of gravitational force



Speed graph in function of time



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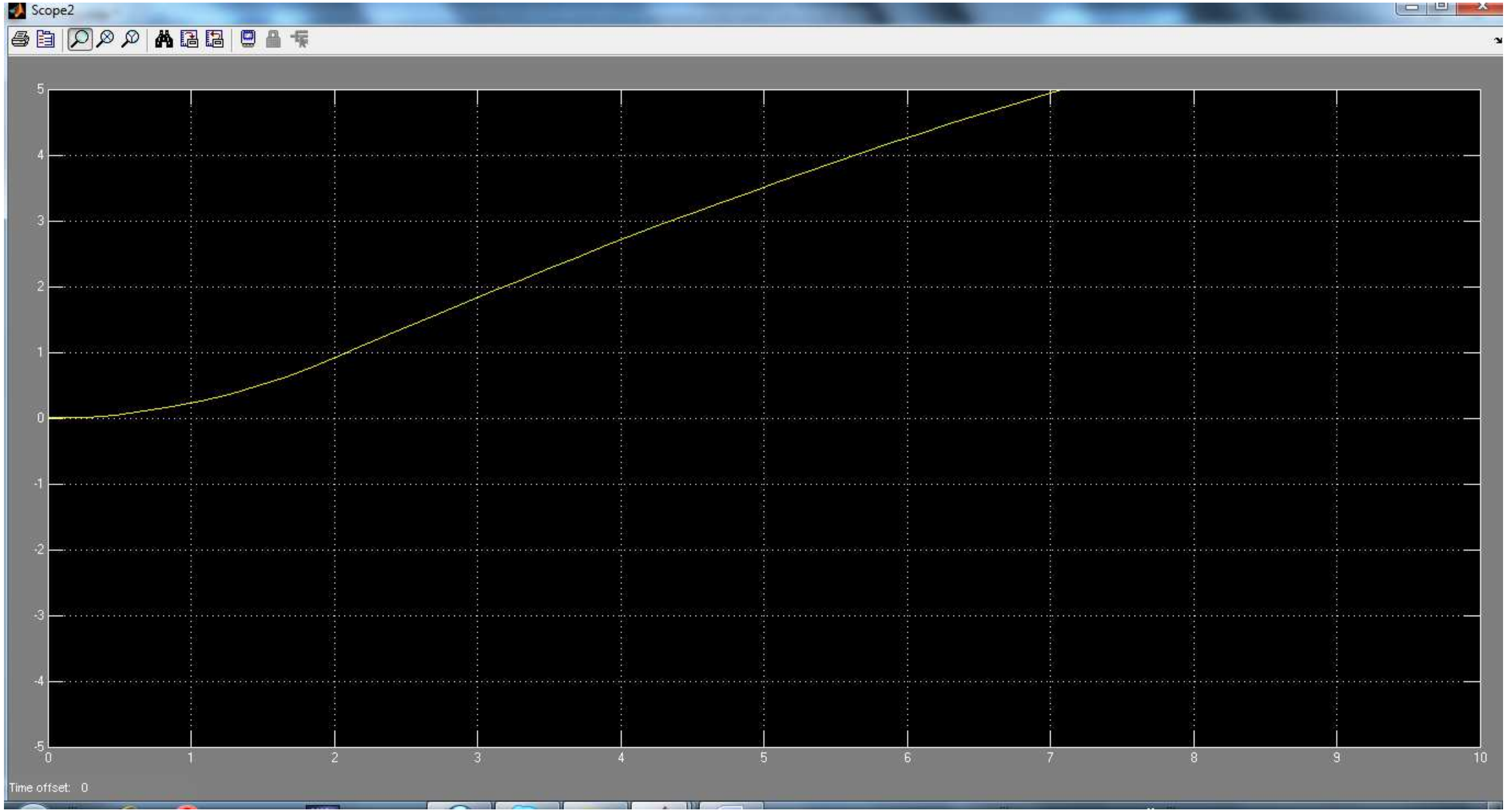
Distance graph in function of time



Conclusion

In this second simulation with simulink we simulated how far the car would role when it started one meter up the three-degree-slope without any power from the solar panel. This means that the only force that makes the car move is gravity. Taking also into consideration the rolling resistance and the air resistance, we calculated with that the car will roll for 6,657m before it stops. This means that the car will keep rolling for 5,657m after the slope.

Parameter list

In this paragraph the different parameters we use are listed, with their respective units. Also a couple of calculation mechanisms we used are included below.

```
%%% Solar Power
Ir = 800 ; % W/m^2
Isc = 0.85  ; %Ampere
Voc = 0.56; %Volt
Is= 10e-8; %Ampere
Ir0=800;%W/m^2
Rs=0;%Ohm
N =1.01;% Quality factor
%%% Motor parameters
Ra =3.2  ; %ohm
Kt=8.55e-3  ; %Nm/A
Fm =8.93e-4;
La=0.222 ; %mH
Im =4.29  ;% g*cm^2
Cm =0.1e-10 ;% N*m/(rad/s)
%%% SSV parameter
m =1; % kg
r =0.03; % wheel radius [m]
E = 9; % gear ratio
angle=3;der % degrees
Cd=0.09;% drag coefficient
A=0.0316;% surface area
d=1.204;% air density

tn=[]; %% initialize empty vector
result=[];

for n=1:20
tn=[tn E];    %% Extend vector with gear ratio n

sim('solarcarandload',20); % Simulate Simulink model for 10 sec.

[i,j]=find(yout(:,2)>14); % find when position of 14 m is achieved
```

```
if isempty(i)
    result =[result 10]; %% if not achieved take time =10 sec
else
    result=[result tout(i(1))]; %% put travel time in vector
end
end

figure(1)
plot(tn,result,'*') %% plot gear ratio versus travel time
xlabel('E');
ylabel('t');
[opt,i]=min(result); %%% find minimal travel time

n=tn(i); %% take gear ratio corresponding with minimal travel time
sim('solarcarandload',10);
```