

Analysis of parameter variation

```
load newBattery.mat;  
load ukfBatteryParams.mat;  
names = ['a', 'b', 'c'];  
u = 1;
```

Analysis of parameter variation

determine the affect of altering various battery parameters

- Increasing R0

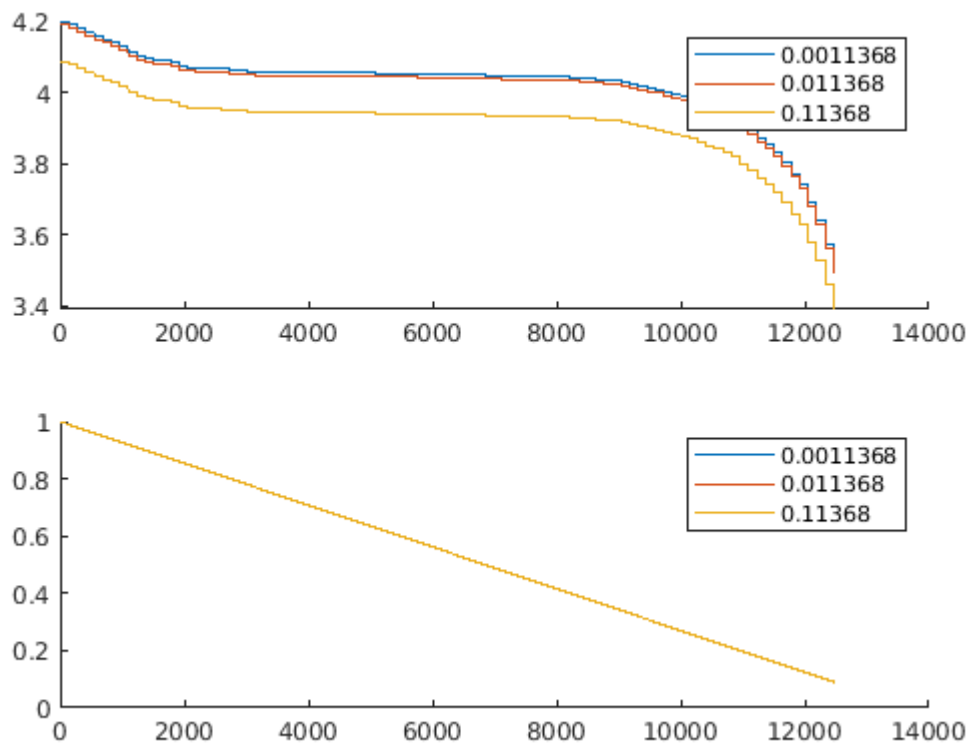
```
disp(battery.R0);
```

0.0011

```
for i = 1:3  
    simout = sim('batteryMine');  
    voltages.(names(i)) = simout.voltage.Data;  
    socs.(names(i)) = simout.soc.Data;  
    ros.(names(i)) = battery.R0;  
    battery.R0 = battery.R0 * 10;  
end  
battery.R0 = ros.a;  
disp(battery.R0);
```

0.0011

```
f1 = figure(1); clf;  
subplot(2,1,1);  
hold on;  
plot(voltages.a);  
plot(voltages.b);  
plot(voltages.c);  
hold off;  
legend(num2str(ros.a), num2str(ros.b), num2str(ros.c));  
  
subplot(2,1,2);  
hold on;  
plot(socs.a);  
plot(socs.b);  
plot(socs.c);  
hold off;  
legend(num2str(ros.a), num2str(ros.b), num2str(ros.c));
```



Changing R_0 changes the output voltage, but the voltage curve and the SOC are unaffected.

- Decrease Q

```
disp(battery.Q);
```

```
3.8000
```

```
for i = 1:3
    simout = sim('batteryMine');
    voltages.(names(i)) = simout.voltage.Data;
    socs.(names(i)) = simout.soc.Data;
    qs.(names(i)) = battery.Q;
    battery.Q = battery.Q * .9;
end
battery.Q = qs.a;
disp(battery.Q);
```

```
3.8000
```

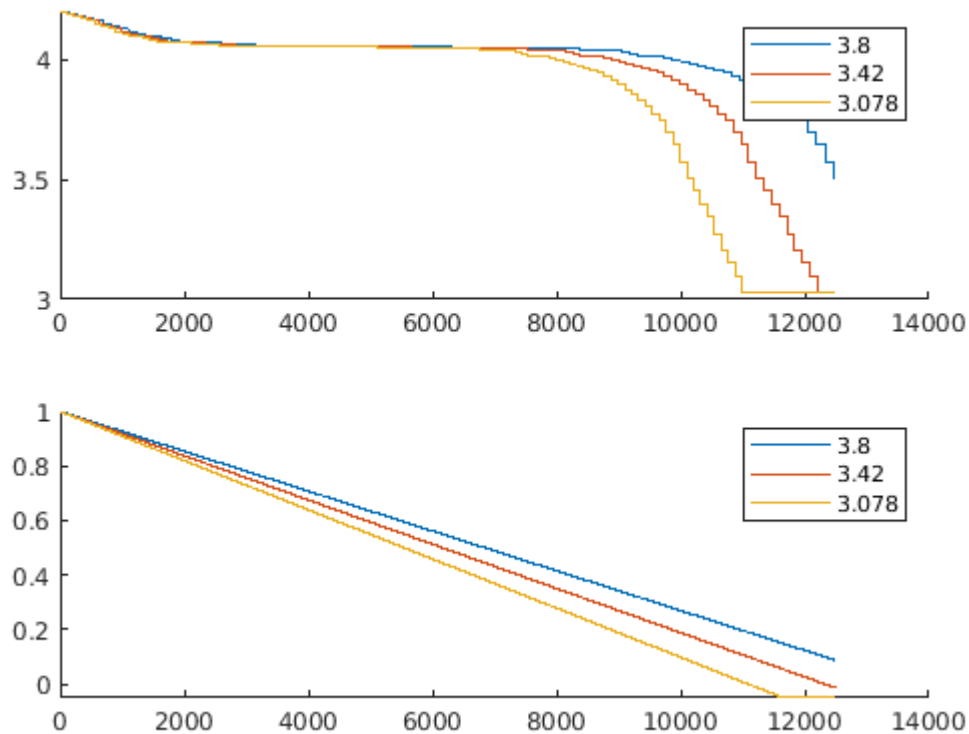
```
f2 = figure(2); clf;
subplot(2,1,1);
hold on;
plot(voltages.a);
plot(voltages.b);
```

```

plot(voltages.c);
hold off;
legend(num2str(qs.a), num2str(qs.b), num2str(qs.c));

subplot(2,1,2);
hold on;
plot(socs.a);
plot(socs.b);
plot(socs.c);
hold off;
legend(num2str(qs.a), num2str(qs.b), num2str(qs.c));

```



Decreasing Q decreases the battery capacity and SOC slope

- Decrease coulombic efficiency by increasing battery.n

```
disp(battery.n);
```

```
0.9987
```

```

for i = 1:3
    simout = sim('batteryMine');
    voltages.(names(i)) = simout.voltage.Data;
    socs.(names(i)) = simout.soc.Data;
    qs.(names(i)) = battery.n;
    battery.n = battery.n * 1.1;
end

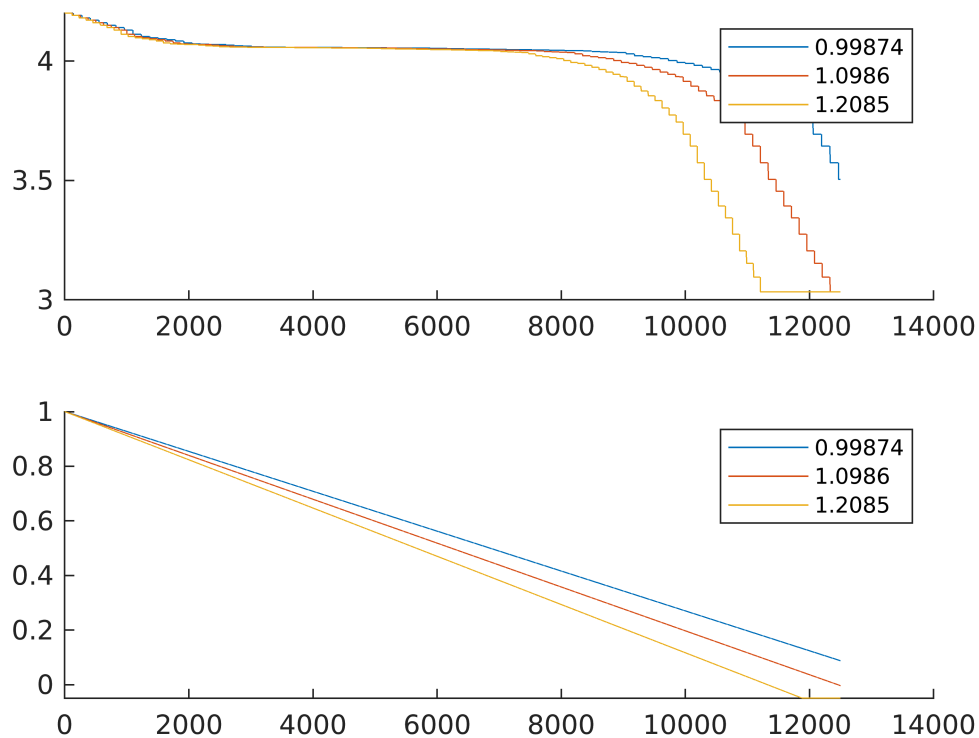
```

```
battery.n = qs.a;
disp(battery.n);
```

0.9987

```
f2 = figure(2); clf;
subplot(2,1,1);
hold on;
plot(voltages.a);
plot(voltages.b);
plot(voltages.c);
hold off;
legend(num2str(qs.a), num2str(qs.b), num2str(qs.c));

subplot(2,1,2);
hold on;
plot(socs.a);
plot(socs.b);
plot(socs.c);
hold off;
legend(num2str(qs.a), num2str(qs.b), num2str(qs.c));
```



Altering coulombic efficiency results in similar behavior to altering capacity

- increasing battery.R (the resistor in the R-C pair)

```
disp(battery.R);
```

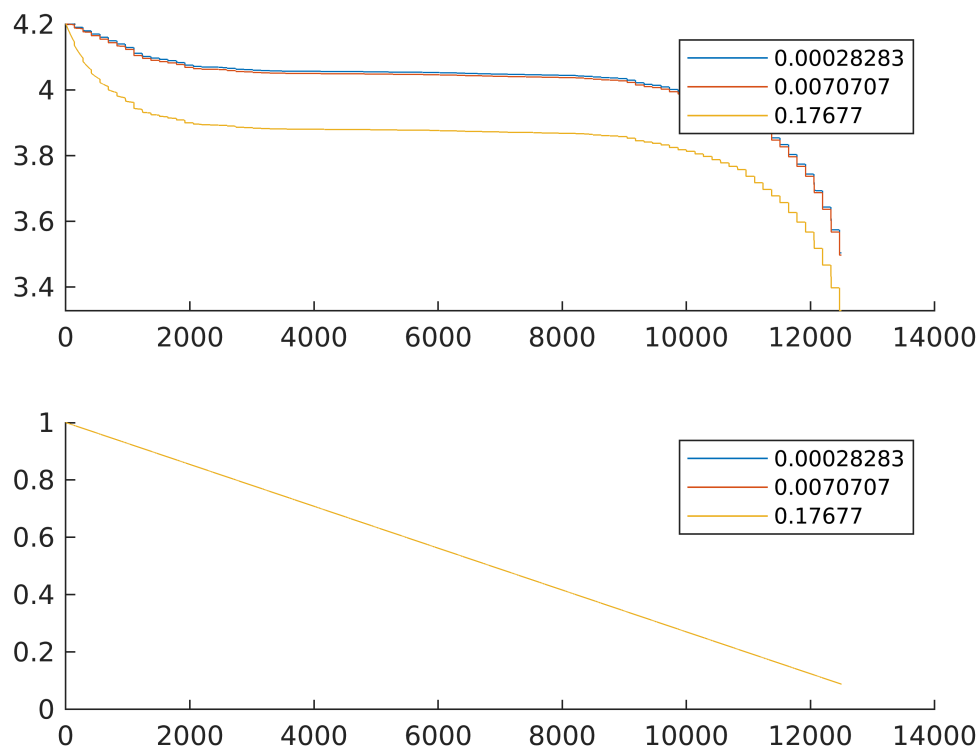
2.8283e-04

```
for i = 1:3
    simout = sim('batteryMine');
    voltages.(names(i)) = simout.voltage.Data;
    socs.(names(i)) = simout.soc.Data;
    qs.(names(i)) = battery.R;
    battery.R = battery.R * 25;
end
battery.R = qs.a;
disp(battery.R);
```

2.8283e-04

```
f2 = figure(2); clf;
subplot(2,1,1);
hold on;
plot(voltages.a);
plot(voltages.b);
plot(voltages.c);
hold off;
legend(num2str(qs.a), num2str(qs.b), num2str(qs.c));

subplot(2,1,2);
hold on;
plot(socs.a);
plot(socs.b);
plot(socs.c);
hold off;
legend(num2str(qs.a), num2str(qs.b), num2str(qs.c));
```



Increasing R affects the voltage curve, but not the SOC slope

- Altering battery.RC (the capacitor in the R-C pair)

```
disp(battery.RC);
```

3.6572

```
for i = 1:3
    simout = sim('batteryMine');
    voltages.(names(i)) = simout.voltage.Data;
    socs.(names(i)) = simout.soc.Data;
    qs.(names(i)) = battery.RC;
    battery.RC = battery.RC / 20;
end
battery.RC = qs.a;
disp(battery.RC);
```

3.6572

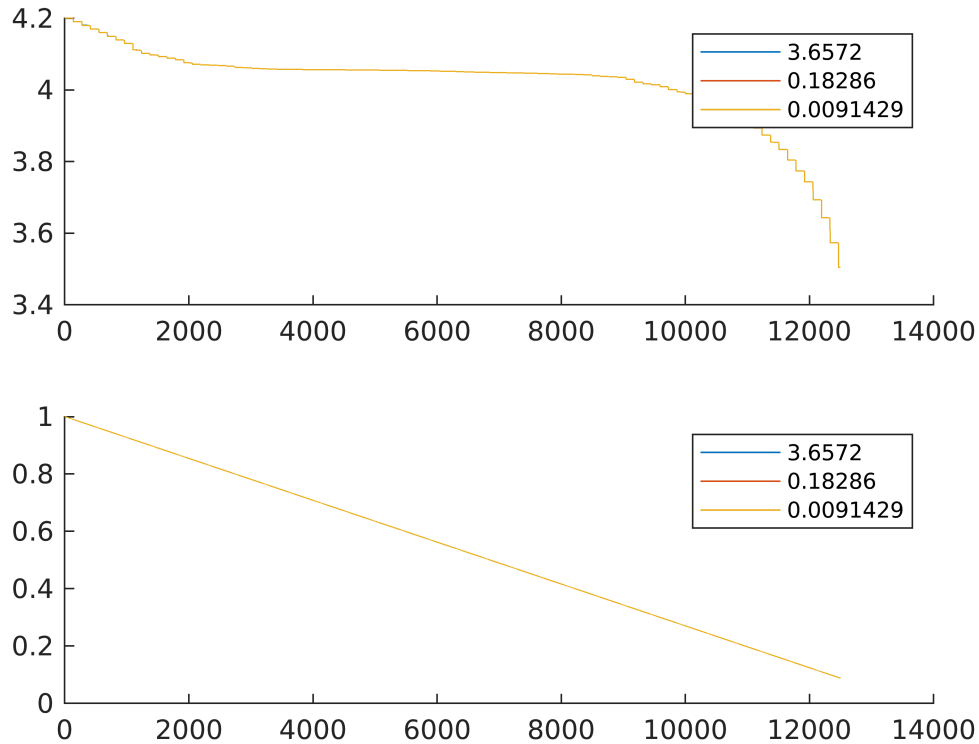
```
f2 = figure(2); clf;
subplot(2,1,1);
hold on;
plot(voltages.a);
plot(voltages.b);
```

```

plot(voltages.c);
hold off;
legend(num2str(qs.a), num2str(qs.b), num2str(qs.c));

subplot(2,1,2);
hold on;
plot(socs.a);
plot(socs.b);
plot(socs.c);
hold off;
legend(num2str(qs.a), num2str(qs.b), num2str(qs.c));

```



Changing this parameter does not alter the SOC slope or voltage curve

- Degrade R0, R, and Q at the same time

```
disp(battery.R);
```

2.8283e-04

```
disp(battery.R0);
```

0.0011

```
disp(battery.Q);
```

3.8000

```

for i = 1:3
    simout = sim('batteryMine');
    voltages.(names(i)) = simout.voltage.Data;
    socs.(names(i)) = simout.soc.Data;
    rs.(names(i)) = battery.R;
    r0s.(names(i)) = battery.R0;
    qs.(names(i)) = battery.Q;
    battery.R = battery.R * 25;
    battery.R0 = battery.R0 * 10;
    battery.Q = battery.Q * .9;
end
battery.R = rs.a;
battery.R0 = r0s.a;
battery.Q = qs.a;
disp(battery.R);

```

2.8283e-04

```

f2 = figure(2); clf;
subplot(2,1,1);
hold on;
plot(voltages.a);
plot(voltages.b);
plot(voltages.c);
hold off;
legend(num2str(qs.a), num2str(qs.b), num2str(qs.c));

subplot(2,1,2);
hold on;
plot(socs.a);
plot(socs.b);
plot(socs.c);
hold off;
legend(num2str(qs.a), num2str(qs.b), num2str(qs.c));

```