Analysing and plotting PPG pulses

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This code was developed by Miodrag Bolic for the book PERVASIVE CARDIOVASCULAR AND RESPIRATORY MONITORING DEVICES

The this section is based on a code PulseAnalyze.m developed by Peter H. Charlton.

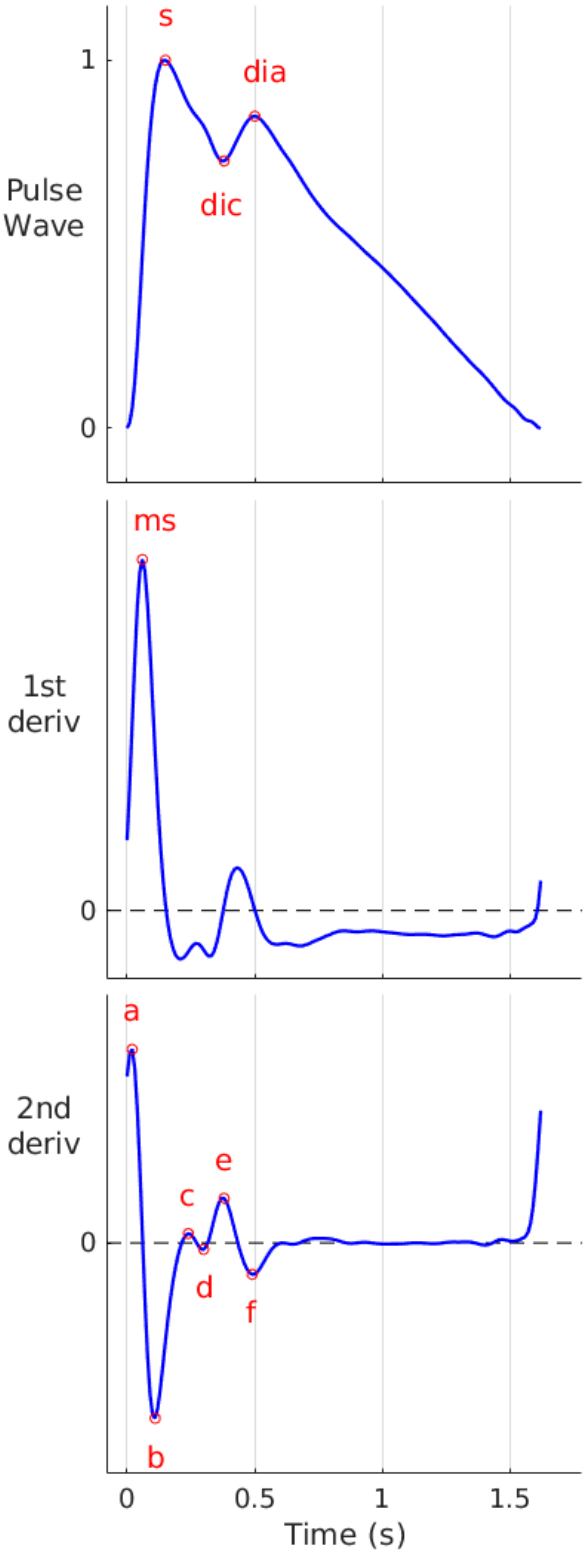
```
% Changing the path from main_folder to a particular chapter
main_path=fileparts(which('Main_Content.mlx'));
if ~isempty(main_path)
    %addpath(append(main_path,'/Chapter2'))
    cd (append(main_path,'/Chapter6/PulseAnalyze'))
    addpath(append(main_path,'/Service'))
end
SAVE_FLAG=1; % saving the figures in a file
```

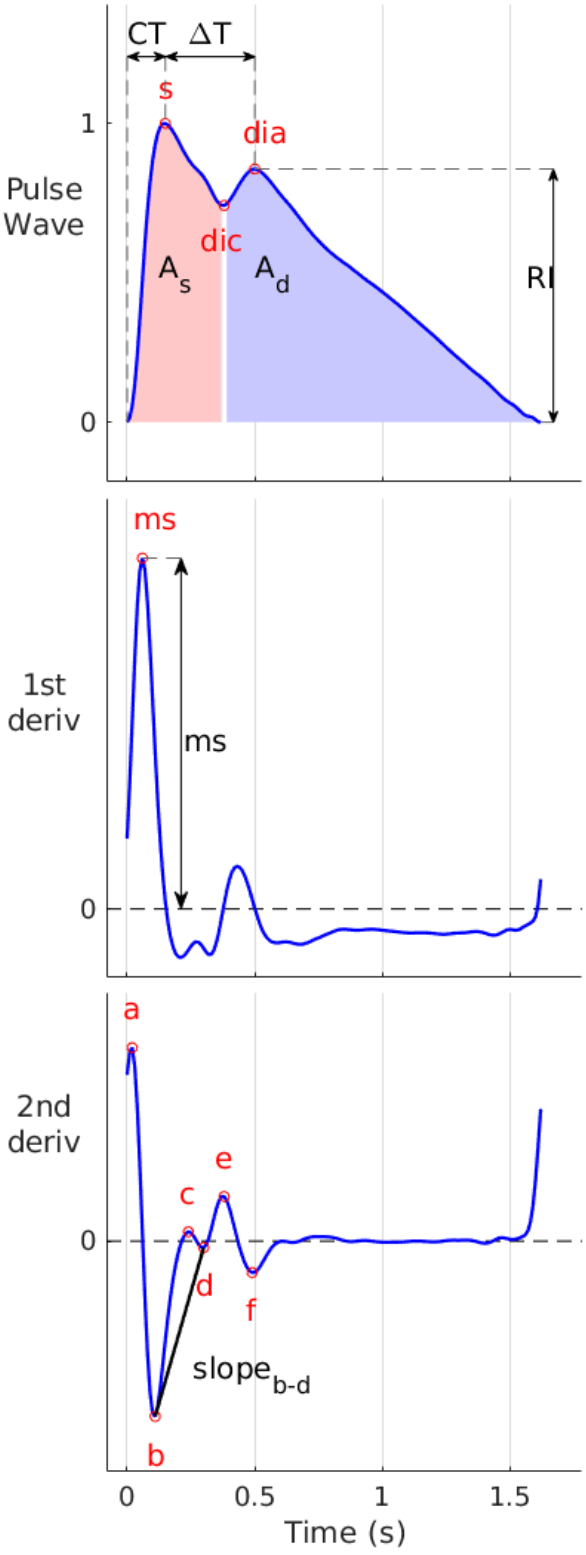
Introduction

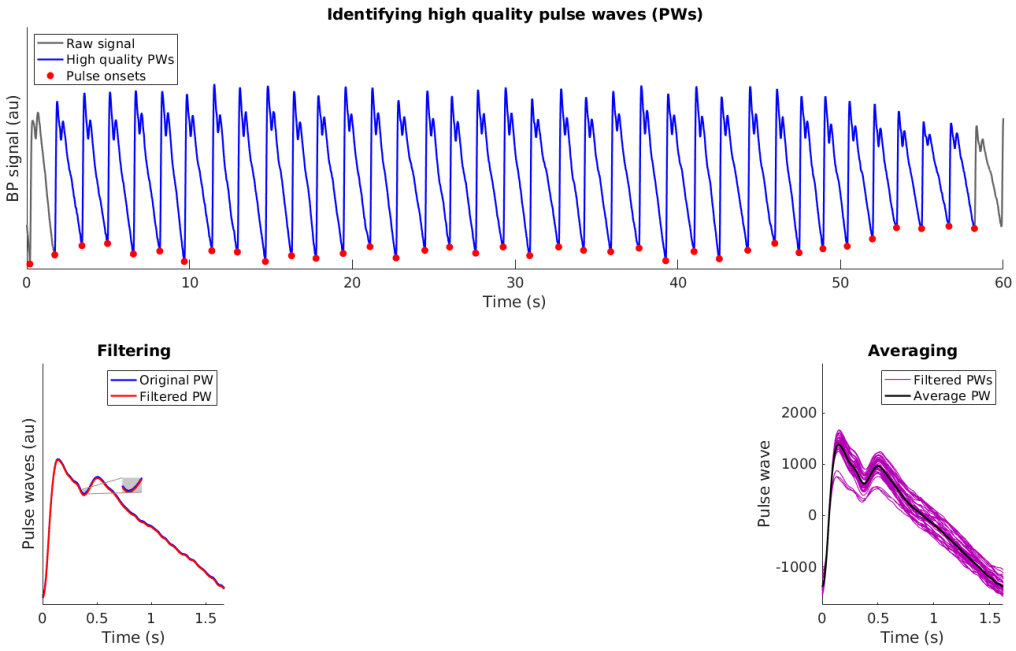
In this notebook, we present pulse analysis based on the software package developed by Peter H. Charlton. In the end of the notebook, we show examples of realistic red and infrared PPG signals.

Analysis of the signal using PulseAnalyse code

```
options.downsample =0;
options.calc_average_pw=1;
options.plot_areas =1;
load('PPGdiary1_1_min_sample.mat') % data is obtained from https://peterhcharlton.githu
[pw_inds, fid_pts, pulses, sigs] = PulseAnalyse(S,options);
```

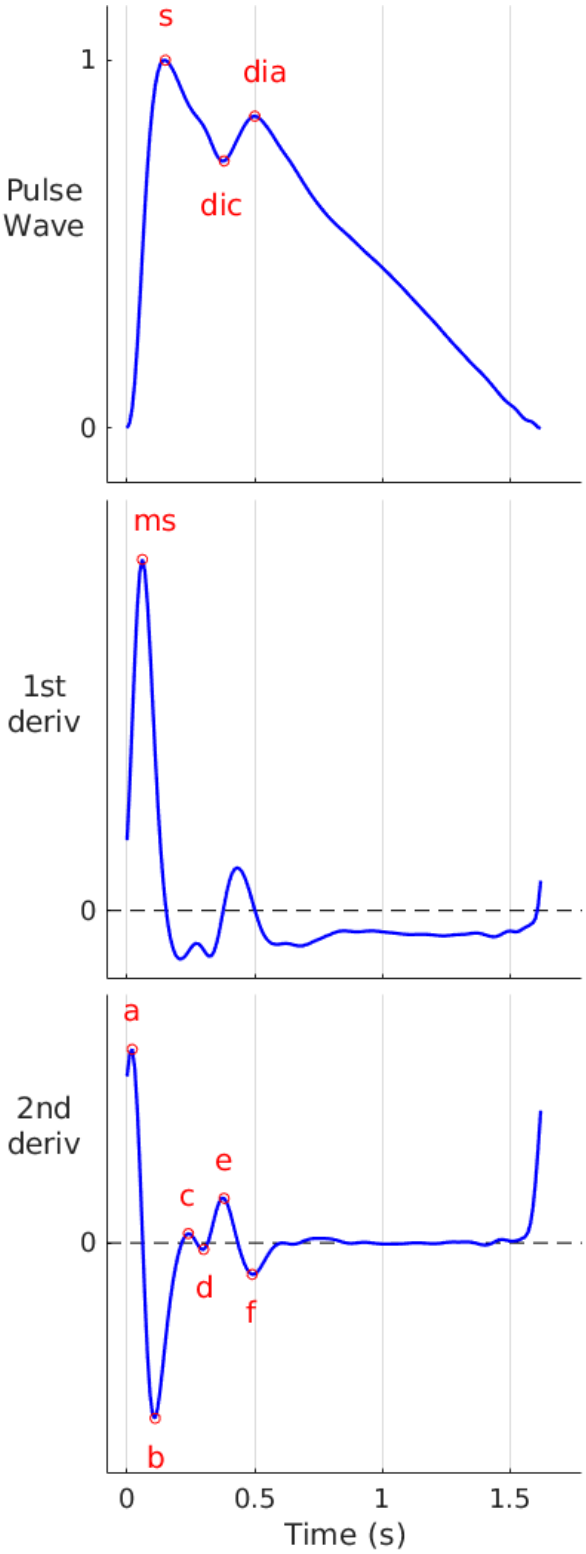

s
dia
dic
1
Pulse
Wave
0
ms
1st
deriv
0
a
e
c
d
f
2nd
deriv
0
b
0
0.5
1
1.5
Time (s)


CT
ΔT
s
dia
dic
1
Pulse
Wave
0
A_s
A_d
RI
ms
1st
deriv
ms
0
a
2nd
deriv
e
c
0
d
f
slope_b-d
b
0
0.5
1
1.5
Time (s)



Ploting the ensamble average

```
figure, plot(sigs.pws, 'b')
hold on, plot(sigs.ave, 'k', 'lineWidth', 5)
xlabel('Time (s)', 'FontSize', 10)
ylabel('Normalized amplitude', 'FontSize', 10)
title('PPG pulses and ensemble averaged pulse')
 exportgraphics(gcf,"Fig6.21.jpg", 'Resolution',600)
```


s
dia
dic
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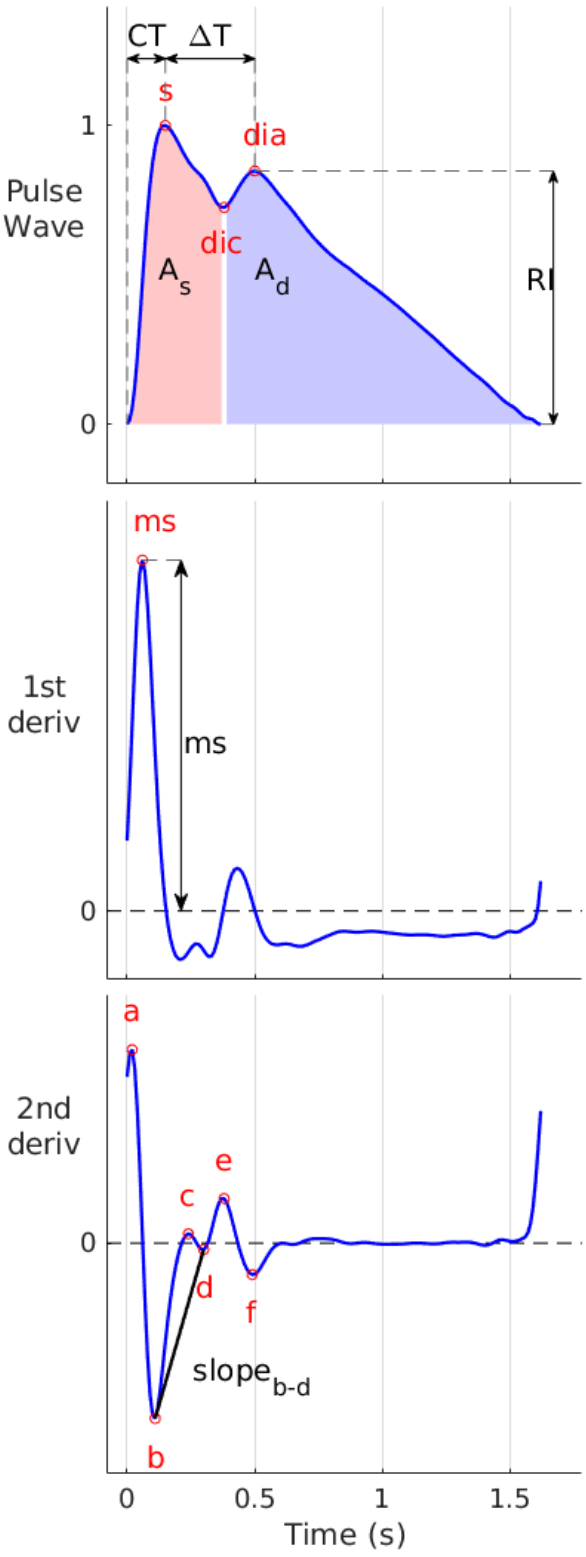
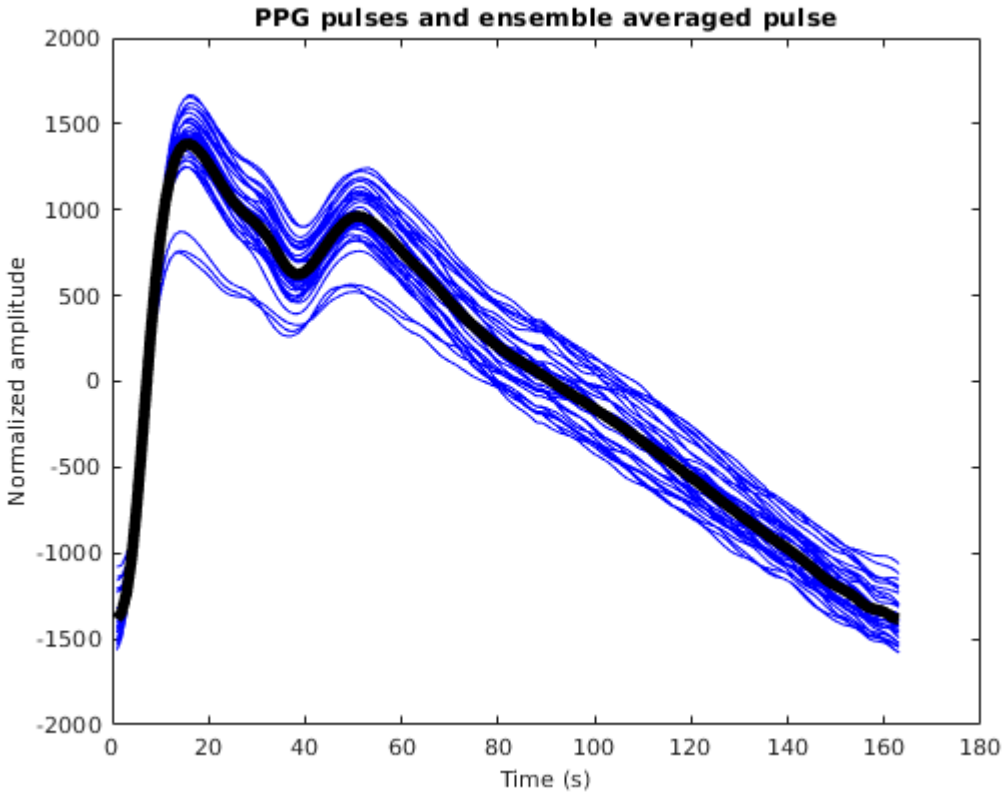
Pulse
Wave
0
ms
1st
deriv
0
a
e
c
d
f
2nd
deriv
0
b
0
0.5
1
1.5
Time (s)


CT
ΔT
s
dia
dic
1
Pulse
Wave
0
A_s
A_d
RI
ms
1st
deriv
ms
0
a
2nd
deriv
e
c
0
d
f
slope_b-d
b
0
0.5
1
1.5
Time (s)

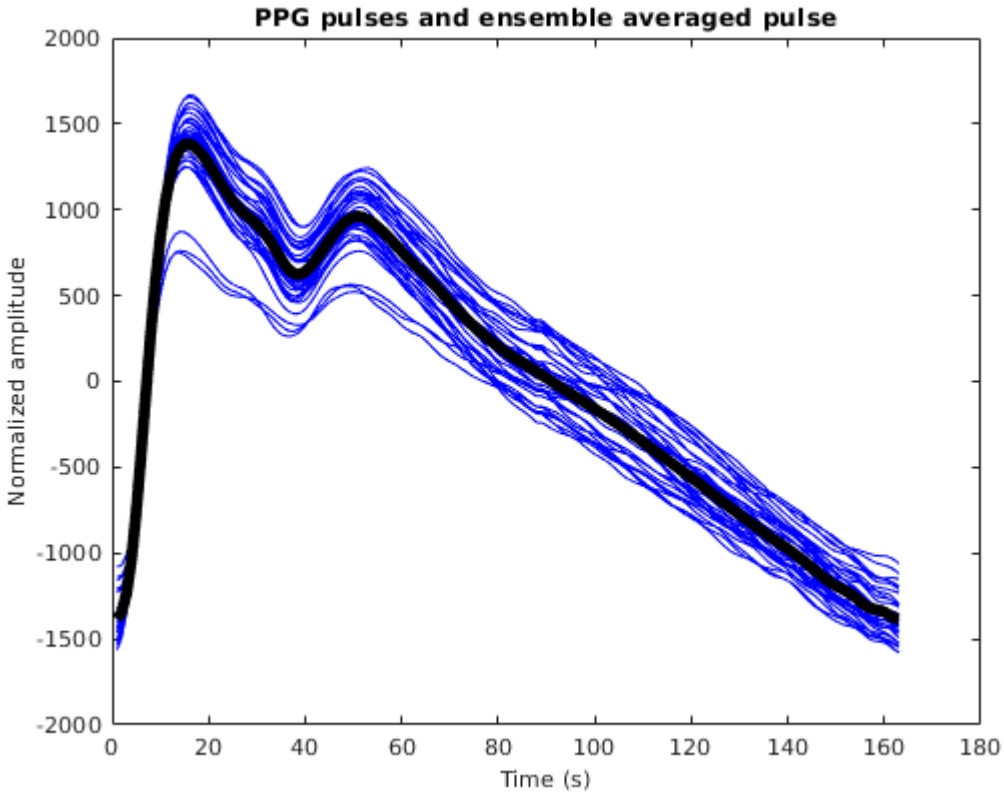


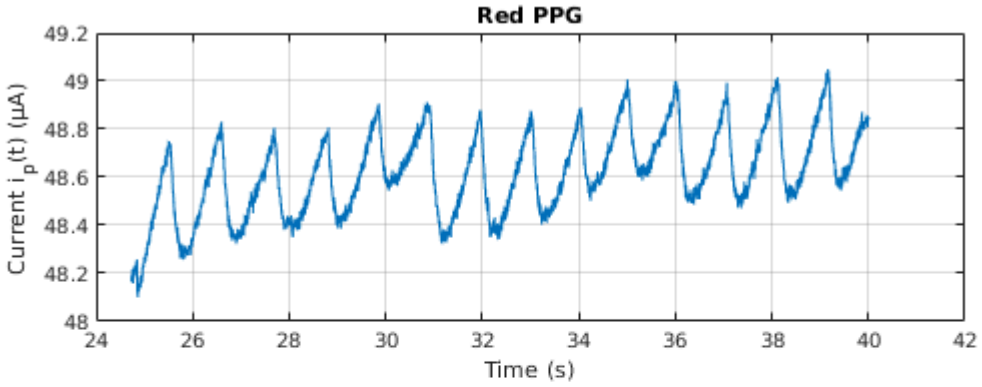
Visualising realistic signals obtained from red and infrared LEDs

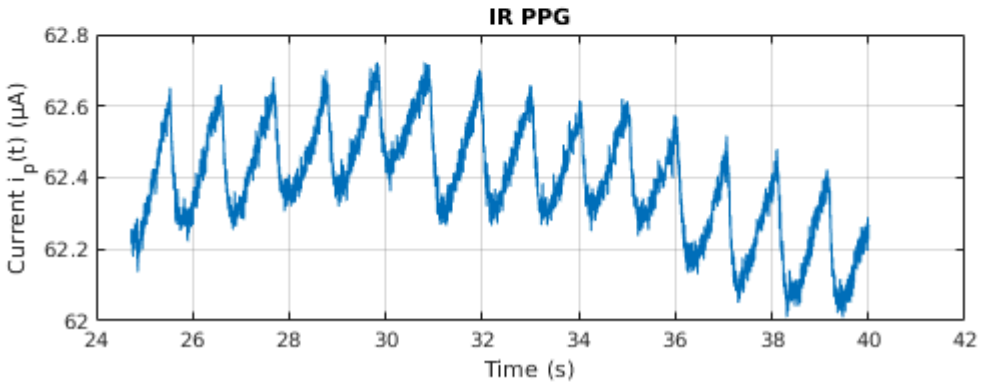
Data is obtained form the finger using the reflective mode PPG. SpO2 is about 96%. It is useful to visualize the data. The fiirst column is the signal from the red PPG and and second column is the signal obtained from the IR PPG. The sampling rate is 250 samples per second.

```
load('PPG_Data1.mat')

fs=250;
t=1/fs:1/fs:length(PPG_Data1)/fs;
start1 =6182;
figure,
subplot(211)
plot(t(start1:end),PPG_Data1(start1:end,1))
xlabel('Time (s)', 'FontSize', 10)
title('Red PPG')
ylabel('Current i_p(t) (μA)', 'FontSize', 10)
grid on
subplot(212) , plot(t(start1:end),PPG_Data1(start1:end,2))
xlabel('Time (s)', 'FontSize', 10)
ylabel('Current i_p(t) (μA)', 'FontSize', 10)
title('IR PPG')
grid on
 exportgraphics(gcf,"Fig6.20.jpg", 'Resolution',600)
```


PPG pulses and ensemble averaged pulse
Normalized amplitude
Time (s)


Red PPG
Current i_p(t) (μA)
Time (s)


IR PPG
Current i_p(t) (μA)
Time (s)