ECG Data Visualization (Milliseconds Scale)

This notebook loads synthetic ECG data with time in milliseconds and creates plots:

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
from scipy.signal import find_peaks
```

Load ECG Data

```
from google.colab import files

# Upload the CSV file manually
uploaded = files.upload()  # This will prompt you to upload `synthetic_ecg_milliseconds.csv`
```

Choose Files synthetic_e…seconds.csv

- **synthetic_ecg_milliseconds.csv**(text/csv) - 195624 bytes, last modified: 7/25/2025 - 100% done

```
Saving synthetic_ecg_milliseconds.csv to synthetic_ecg_milliseconds (1).csv
```

```
# Load ECG data with time in milliseconds
ecg_df = pd.read_csv('synthetic_ecg_milliseconds.csv')  # Adjust path if needed
time_ms = ecg_df['time_ms'].values
ecg_mV = ecg_df['ecg_mV'].values
```

```
# Show first 10 rows of the ECG data
print("📄 Sample of ECG data:")
display(ecg_df.head(10))
```

```
📄 Sample of ECG data:
```

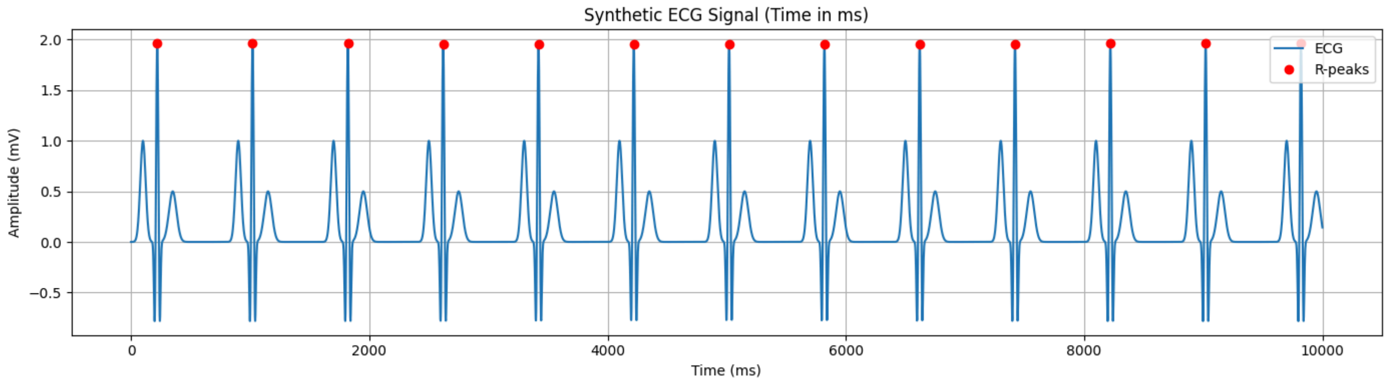
	time_ms	ecg_mV
0	0.000000	0.000045
1	2.000400	0.000067
2	4.000800	0.000099
3	6.001200	0.000145
4	8.001600	0.000211
5	10.002000	0.000304
6	12.002400	0.000434
7	14.002801	0.000614
8	16.003201	0.000863
9	18.003601	0.001202

Detect R-peaks

```
fs = 500  # sampling frequency in Hz
peaks, _ = find_peaks(ecg_mV, height=1.0, distance=fs * 0.6)
r_peak_times_ms = time_ms[peaks]
```

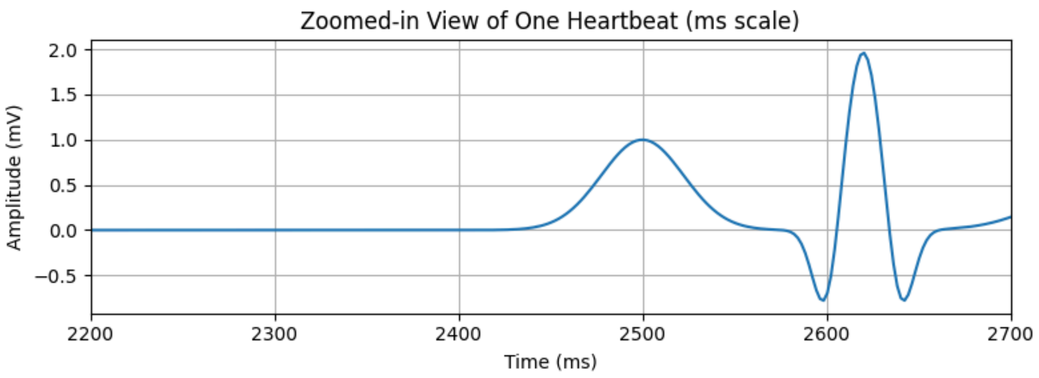
Plot Full ECG Signal with R-peaks

```
plt.figure(figsize=(14, 4))
plt.plot(time_ms, ecg_mV, label='ECG')
plt.plot(r_peak_times_ms, ecg_mV[peaks], 'ro', label='R-peaks')
plt.title('Synthetic ECG Signal (Time in ms)')
plt.xlabel('Time (ms)')
plt.ylabel('Amplitude (mV)')
plt.legend()
plt.grid(True)
plt.tight_layout()
plt.show()
```



Zoomed-in View of One Heartbeat

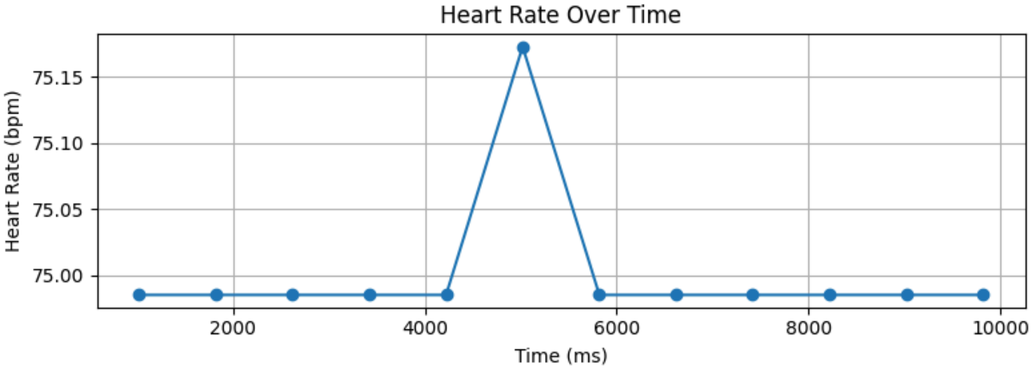
```
plt.figure(figsize=(8, 3))
plt.plot(time_ms, ecg_mV)
plt.xlim(2200, 2700)
plt.title('Zoomed-in View of One Heartbeat (ms scale)')
plt.xlabel('Time (ms)')
plt.ylabel('Amplitude (mV)')
plt.grid(True)
plt.tight_layout()
plt.show()
```



Heart Rate Over Time

```
rr_intervals_s = np.diff(r_peak_times_ms) / 1000.0
heart_rate_bpm = 60 / rr_intervals_s
hr_time_ms = r_peak_times_ms[1:]

plt.figure(figsize=(8, 3))
plt.plot(hr_time_ms, heart_rate_bpm, marker='o')
plt.title('Heart Rate Over Time')
plt.xlabel('Time (ms)')
plt.ylabel('Heart Rate (bpm)')
plt.grid(True)
plt.tight_layout()
plt.show()
```


Heart Rate Over Time
Heart Rate (bpm)
75.15
75.10
75.05
75.00
2000
4000
6000
8000
10000
Time (ms)