```matlab
% Load the EMG data and extract the 3rd channel
data = load('EMG.mat');
varNames = fieldnames(data);
EMG = data.(varNames{1});
channel3 = EMG(:, 3);
fs_original = 2000; % Sampling frequency in Hz

% Time vector for original signal
t_original = (0:length(channel3)-1) / fs_original;

%% (a) Using 'decimate' to downsample
target_fs_a = [1000, 400, 200];
D_a = fs_original ./ target_fs_a; % Decimation factors [2, 5, 10]

% Decimate signals
emg_decimate_1000 = decimate(channel3, D_a(1)); % 1000 Hz
emg_decimate_400 = decimate(channel3, D_a(2));   % 400 Hz
emg_decimate_200 = decimate(channel3, D_a(3));  % 200 Hz

% Time vectors for decimated signals
t_decimate_1000 = (0:length(emg_decimate_1000)-1) / target_fs_a(1);
t_decimate_400 = (0:length(emg_decimate_400)-1) / target_fs_a(2);
t_decimate_200 = (0:length(emg_decimate_200)-1) / target_fs_a(3);

%% (b) Using 'downsample' to downsample
% Downsample signals (no filtering)
emg_downsample_1000 = downsample(channel3, D_a(1)); % 1000 Hz
emg_downsample_400 = downsample(channel3, D_a(2));   % 400 Hz
emg_downsample_200 = downsample(channel3, D_a(3));  % 200 Hz

% Time vectors for downsample signals
t_downsample_1000 = t_decimate_1000;
t_downsample_400 = t_decimate_400;
t_downsample_200 = t_decimate_200;

%% (c) Using 'resample' to downsample
target_fs_c = [1500, 800, 200];
p = [3, 2, 1]; % Resampling factors (numerator)
q = [4, 5, 10]; % Resampling factors (denominator)

% Resample signals
emg_resample_1500 = resample(channel3, p(1), q(1)); % 1500 Hz
emg_resample_800 = resample(channel3, p(2), q(2));   % 800 Hz
emg_resample_200 = resample(channel3, p(3), q(3));  % 200 Hz

% Time vectors for resampled signals
t_resample_1500 = (0:length(emg_resample_1500)-1) / target_fs_c(1);
```

```matlab
t_resample_800 = (0:length(emg_resample_800)-1) / target_fs_c(2);
t_resample_200 = (0:length(emg_resample_200)-1) / target_fs_c(3);

%% Plot all in a single figure
figure;

% (a) Decimate plots
subplot(4,1,1);
plot(t_original, channel3, 'b-');
title('Original EMG (2000 Hz)');
xlabel('Time (s)'); ylabel('Amplitude');
grid on;

subplot(4,1,2);
plot(t_original, channel3, 'b-'); hold on;
plot(t_decimate_1000, emg_decimate_1000, 'r-', 'LineWidth', 1.5);
legend('Original', 'Decimated (1000 Hz)');
xlabel('Time (s)'); ylabel('Amplitude');
grid on;

subplot(4,1,3);
plot(t_original, channel3, 'b-'); hold on;
plot(t_decimate_400, emg_decimate_400, 'r-', 'LineWidth', 1.5);
legend('Original', 'Decimated (400 Hz)');
xlabel('Time (s)'); ylabel('Amplitude');
grid on;

subplot(4,1,4);
plot(t_original, channel3, 'b-'); hold on;
plot(t_decimate_200, emg_decimate_200, 'r-', 'LineWidth', 1.5);
legend('Original', 'Decimated (200 Hz)');
xlabel('Time (s)'); ylabel('Amplitude');
grid on;

sgtitle('EMG Downsampling Using decimate()');
```
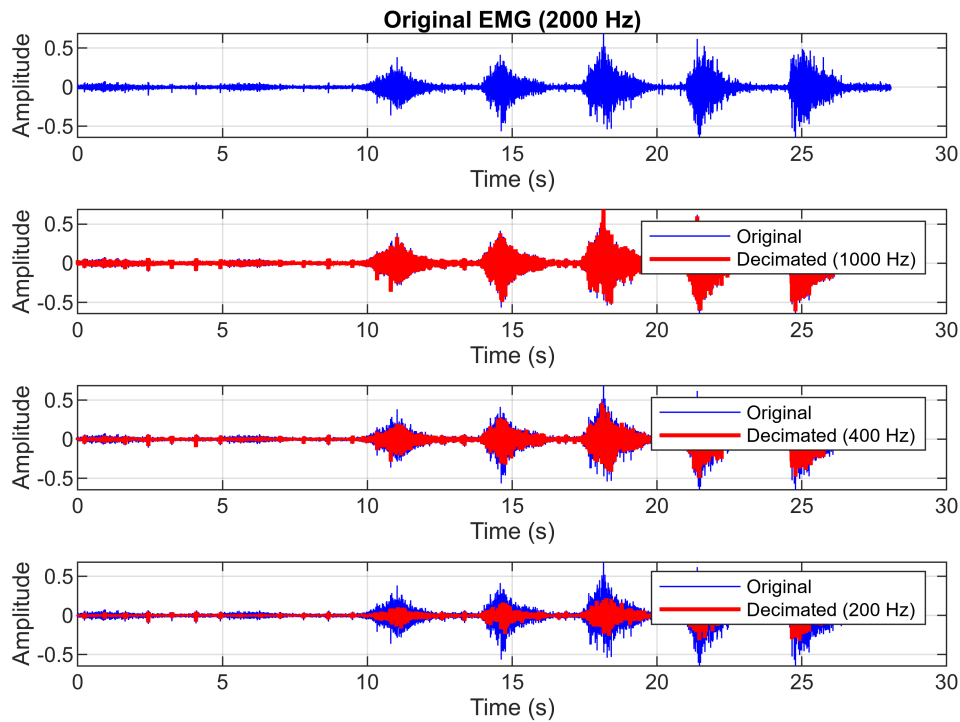
# EMG Downsampling Using decimate()



```matlab
% (b) Downsample plots
figure;
subplot(4,1,1);
plot(t_original, channel3, 'b-');
title('Original EMG (2000 Hz)');
xlabel('Time (s)'); ylabel('Amplitude');
grid on;

subplot(4,1,2);
plot(t_original, channel3, 'b-'); hold on;
plot(t_downsample_1000, emg_downsample_1000, 'g-', 'LineWidth', 1.5);
legend('Original', 'Downsampled (1000 Hz)');
xlabel('Time (s)'); ylabel('Amplitude');
grid on;

subplot(4,1,3);
plot(t_original, channel3, 'b-'); hold on;
plot(t_downsample_400, emg_downsample_400, 'g-', 'LineWidth', 1.5);
legend('Original', 'Downsampled (400 Hz)');
xlabel('Time (s)'); ylabel('Amplitude');
grid on;

subplot(4,1,4);
plot(t_original, channel3, 'b-'); hold on;
plot(t_downsample_200, emg_downsample_200, 'g-', 'LineWidth', 1.5);
```
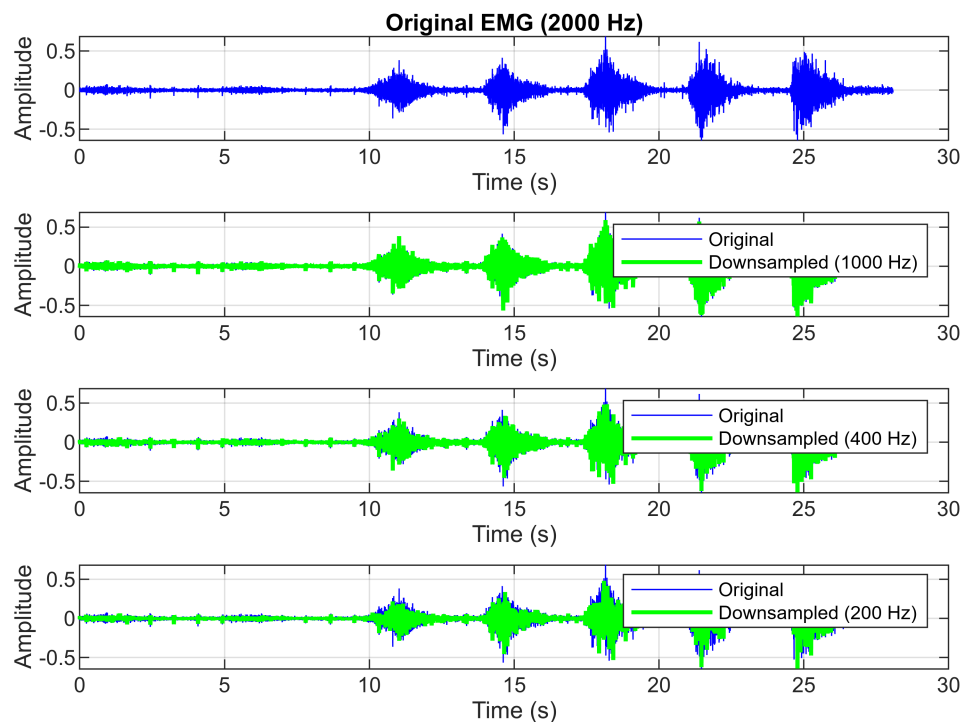
```matlab
legend('Original', 'Downsampled (200 Hz)');
xlabel('Time (s)'); ylabel('Amplitude');
grid on;

sgtitle('EMG Downsampling Using downsample()');
```

## EMG Downsampling Using downsample()



```matlab
% (c) Resample plots
figure;
subplot(4,1,1);
plot(t_original, channel3, 'b-');
title('Original EMG (2000 Hz)');
xlabel('Time (s)'); ylabel('Amplitude');
grid on;

subplot(4,1,2);
plot(t_original, channel3, 'b-'); hold on;
plot(t_resample_1500, emg_resample_1500, 'm-', 'LineWidth', 1.5);
legend('Original', 'Resampled (1500 Hz)');
xlabel('Time (s)'); ylabel('Amplitude');
grid on;

subplot(4,1,3);
plot(t_original, channel3, 'b-'); hold on;
plot(t_resample_800, emg_resample_800, 'm-', 'LineWidth', 1.5);
legend('Original', 'Resampled (800 Hz)');
xlabel('Time (s)'); ylabel('Amplitude');
```
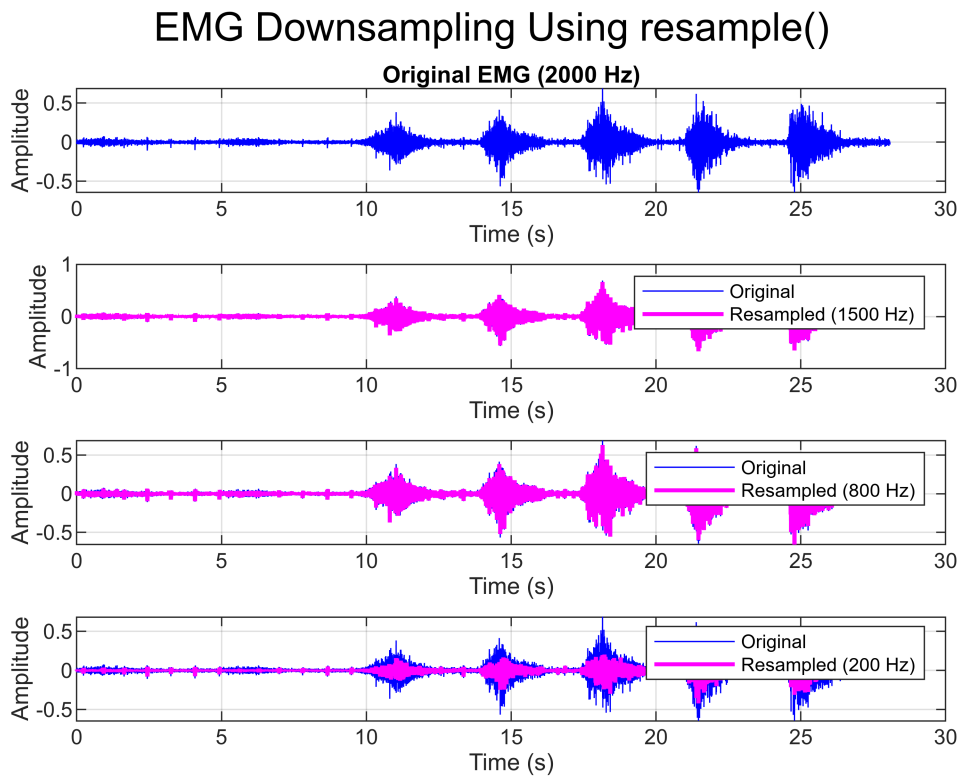
```matlab
grid on;

subplot(4,1,4);
plot(t_original, channel3, 'b-'); hold on;
plot(t_resample_200, emg_resample_200, 'm-', 'LineWidth', 1.5);
legend('Original', 'Resampled (200 Hz)');
xlabel('Time (s)'); ylabel('Amplitude');
grid on;

sgtitle('EMG Downsampling Using resample()');
```

## EMG Downsampling Using resample()



```matlab
%Compare
% When the downsampled frequency  down 1/2 from the original frequency,
% downsample and resample are better than decimate. However, when to
% 1/5 from the original frequency, resample and decimate are better. When
% sample 1/10 from the original frequency, all three are quite bad
% whatever the methods are.
```

```matlab
%Comment
%Best for preserving signal quality will be decimate and resample because both use
filtering. If we
%use downsample, it may have the risk of aliasing because it does not use
%any flitering before downsimpling.
```