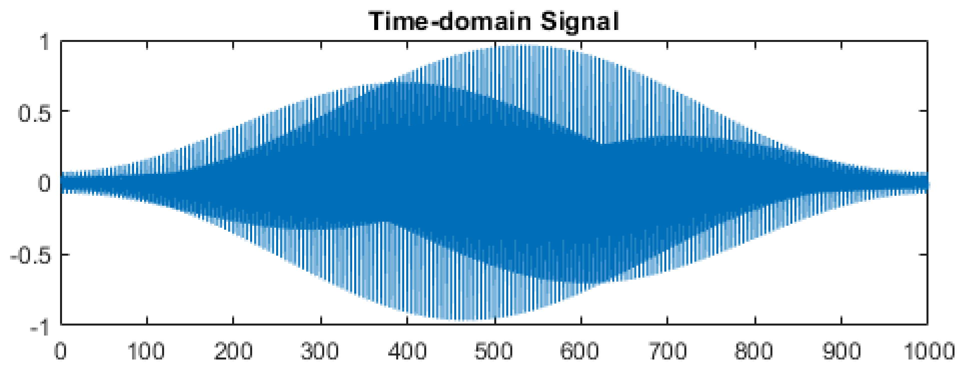
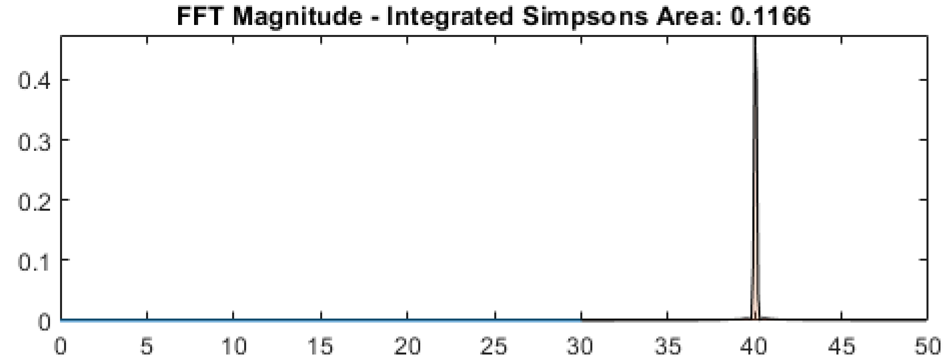
```
function main_function()

    % Constants
    TIMESTEP = 0.01;
    NUMSAMPLES = 1000;
    MOD_FREQ_HZ = 40;
    CHANNEL_SEPARATION_HZ = 40;

    % Main script execution
    signal = generate_signal(TIMESTEP, NUMSAMPLES);
    visualize_signal_and_fft_simpsons(signal, TIMESTEP, MOD_FREQ_HZ,
 CHANNEL_SEPARATION_HZ);

end

function signal = generate_signal(timestep, numsamples)
    t = linspace(0, numsamples*timestep, numsamples);
    windowed_signal = sin(40.0 * 2.0 * pi * t) .* hamming(numsamples).';
    signal = windowed_signal;
end

function [xf, yf] = fft_calculate(data, timestep)
    yf = abs(fft(data));
    numsamples = length(data);
    freq = 0:1/timestep/numsamples:1/timestep - 1/timestep/numsamples;
    xf = freq(1:numsamples/2);
    yf = yf(1:numsamples/2) * 2.0 / numsamples;
end

function [idx, nearestValue] = find_nearest(array, value)
    [~, idx] = min(abs(array - value));
    nearestValue = array(idx);
end

function result = simpsons_integration(xf, yf, idx_start, idx_stop)
    n = idx_stop - idx_start;
    if mod(n, 2) ~= 0
        error('Number of intervals should be even for composite Simpson''s
 rule.');
    end

    h = (xf(idx_stop) - xf(idx_start)) / n;
    result = 0;

    for i = 0:2:n-2
        result = result + (h/3) * (yf(idx_start + i) + 4*yf(idx_start + i + 1)
 + yf(idx_start + i + 2));
    end
end

function visualize_signal_and_fft_simpsons(signal, timestep, mod_freq_hz,
 channel_separation_hz)
```

```
    [xf, yf] = fft_calculate(signal, timestep);

    freq_start = mod_freq_hz - channel_separation_hz / 2;
    freq_stop = mod_freq_hz + channel_separation_hz / 2;

    [idx_start, ~] = find_nearest(xf, freq_start);
    [idx_stop, ~] = find_nearest(xf, freq_stop);

    % Ensure an odd number of indices (even number of intervals) for Simpson's
 rule
    if mod(idx_stop - idx_start, 2) == 1
        idx_stop = idx_stop - 1;
    end

    integrated_area = simpsons_integration(xf, yf, idx_start, idx_stop);

    % Time-domain Signal plot
    subplot(2, 1, 1);
    plot(signal);
    title('Time-domain Signal');

    % FFT Magnitude plot
    subplot(2, 1, 2);
    plot(xf, yf);
    hold on;

    % Highlight Area of Interest
    freq_start = mod_freq_hz - (channel_separation_hz * 0.25);
    freq_stop = mod_freq_hz + (channel_separation_hz * 0.25);
    [idx_start, ~] = find_nearest(xf, freq_start);
    [idx_stop, ~] = find_nearest(xf, freq_stop);

    area(xf(idx_start:idx_stop), yf(idx_start:idx_stop), 'FaceAlpha', 0.2);
    title(['FFT Magnitude - Integrated Simpsons Area: ',
 num2str(integrated_area, '%.4f')]);
    hold off;
end
```





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