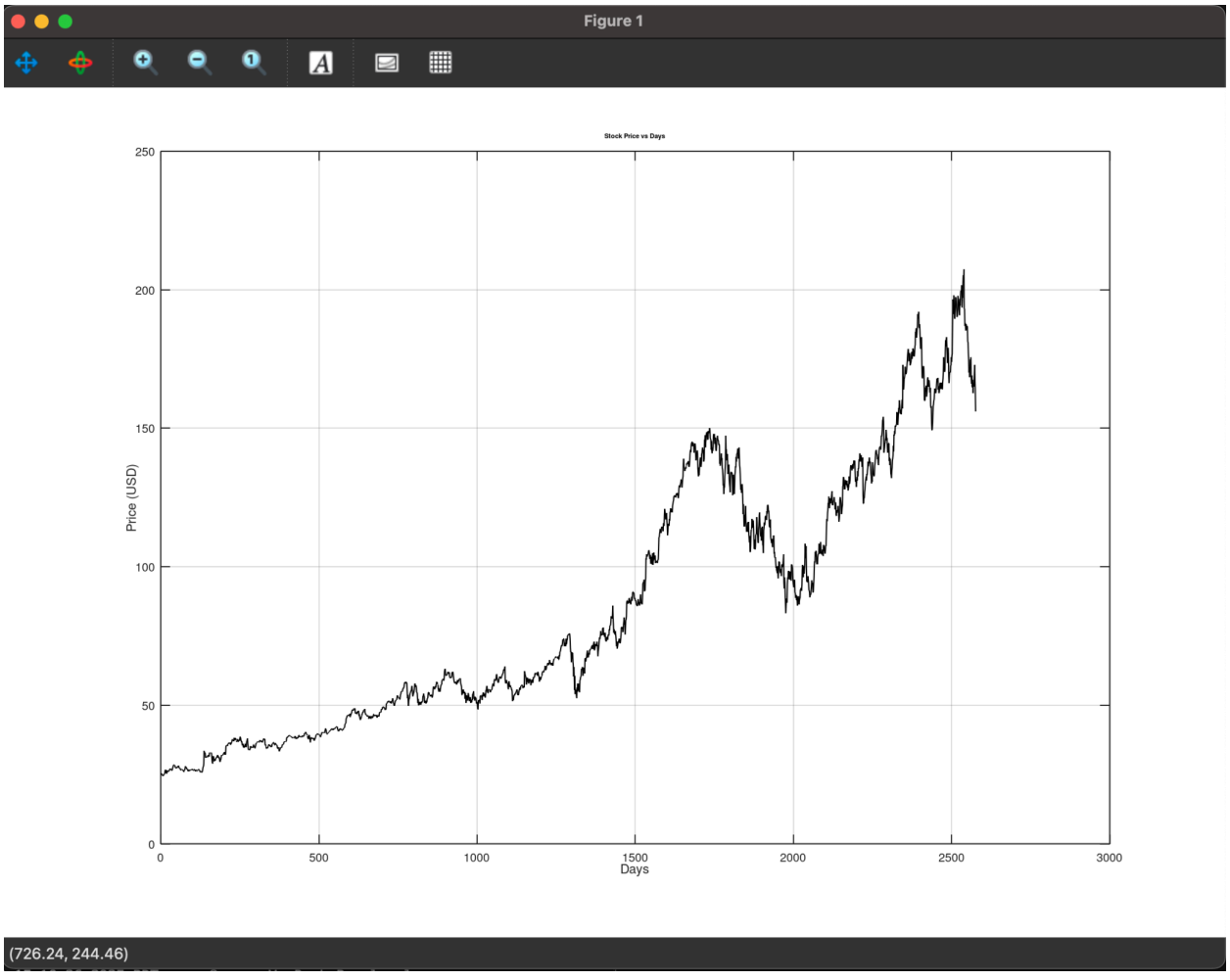
2 Discrete Dourier Transform, Applications

1)

Octave Code:

```
data = csvread('StockData_2015_2025.csv', 1, 0);
days = data(:, 1);
prices = data(:, 2);
figure;
plot(days, prices, '-', 'color', 'black');
xlabel('Days');
ylabel('Price (USD)');
title('Stock Price vs Days');
grid on;
```

Plot:

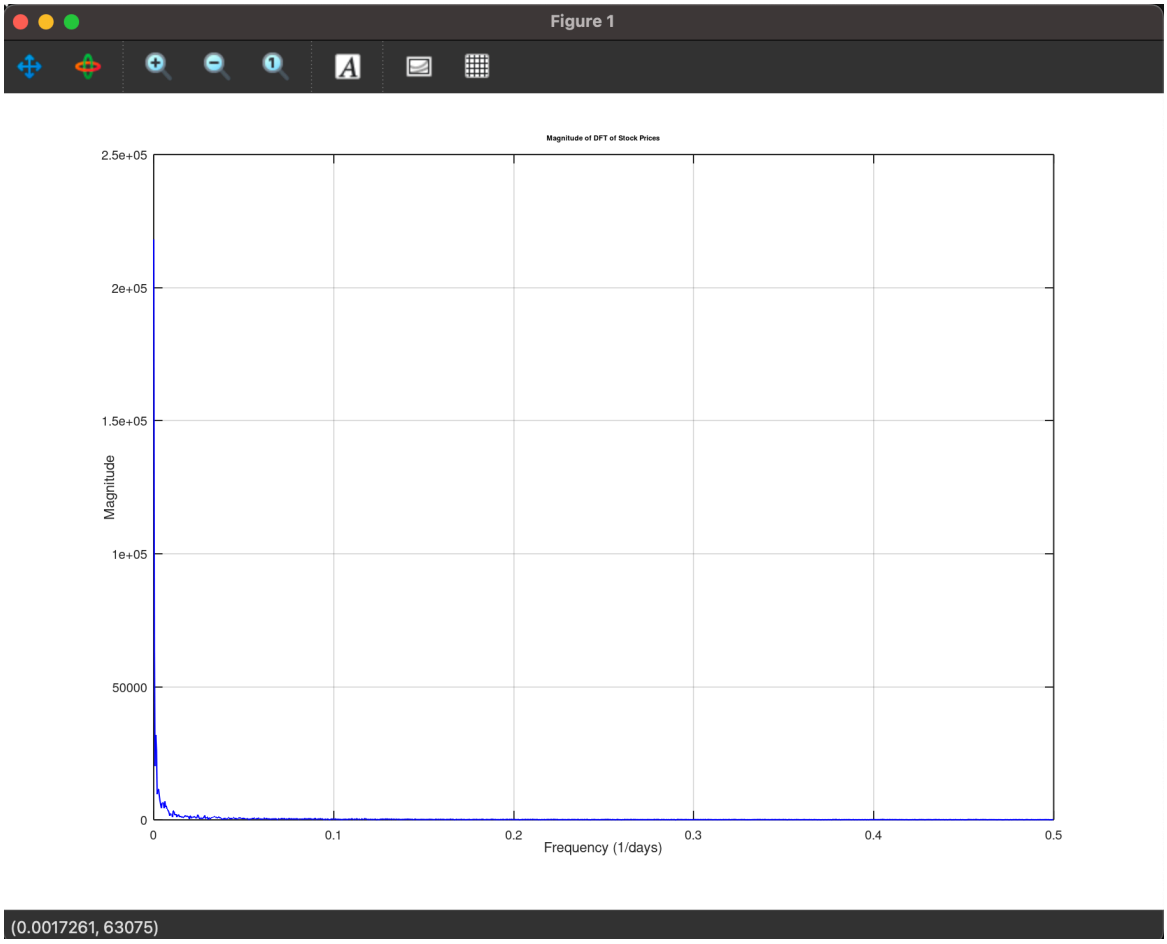


2)

Octave Code:

```
N = length(prices);
Y = fft(prices);
mag = abs(Y);
fs = 1; % 1 sample per day
f = (0:N-1)*(fs/N);
f = f(1:floor(N/2));
mag = mag(1:floor(N/2));
figure;
plot(f, mag, 'b');
xlabel('Frequency (1/days)');
ylabel('Magnitude');
title('Magnitude of DFT of Stock Prices');
grid on;
```

Plot:



3)

The DFT graph shows a significant peak at a frequency of approximately 0.00173 (1/days), corresponding to a repeating cycle of about 579 days, or 1.6 years. This shows that the stock price of Google Alphabet Inc. may follow a recurring trend about every 1.6 years, maybe due to market cycles or any other business patterns.

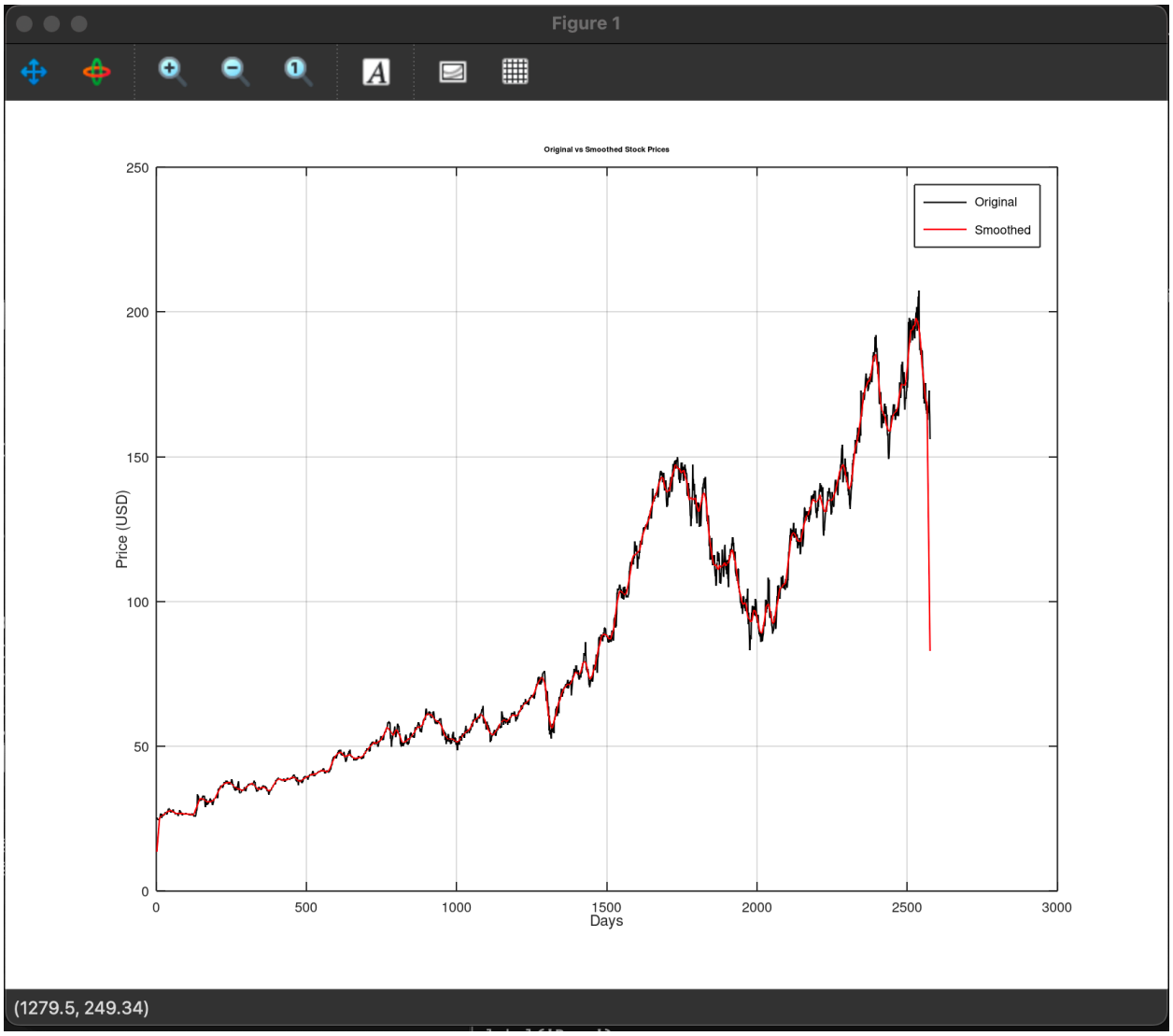
3 Filter Design

1)

Octave Code:

```
window_size = 20;
kernel = ones(1, window_size) / window_size;
smoothed_prices = conv(prices, kernel, 'same');
figure;
plot(days, prices, 'k'); hold on;
plot(days, smoothed_prices, 'r');
xlabel('Days');
ylabel('Price (USD)');
title('Original vs Smoothed Stock Prices');
legend('Original', 'Smoothed');
grid on;
```

Plot:



2)

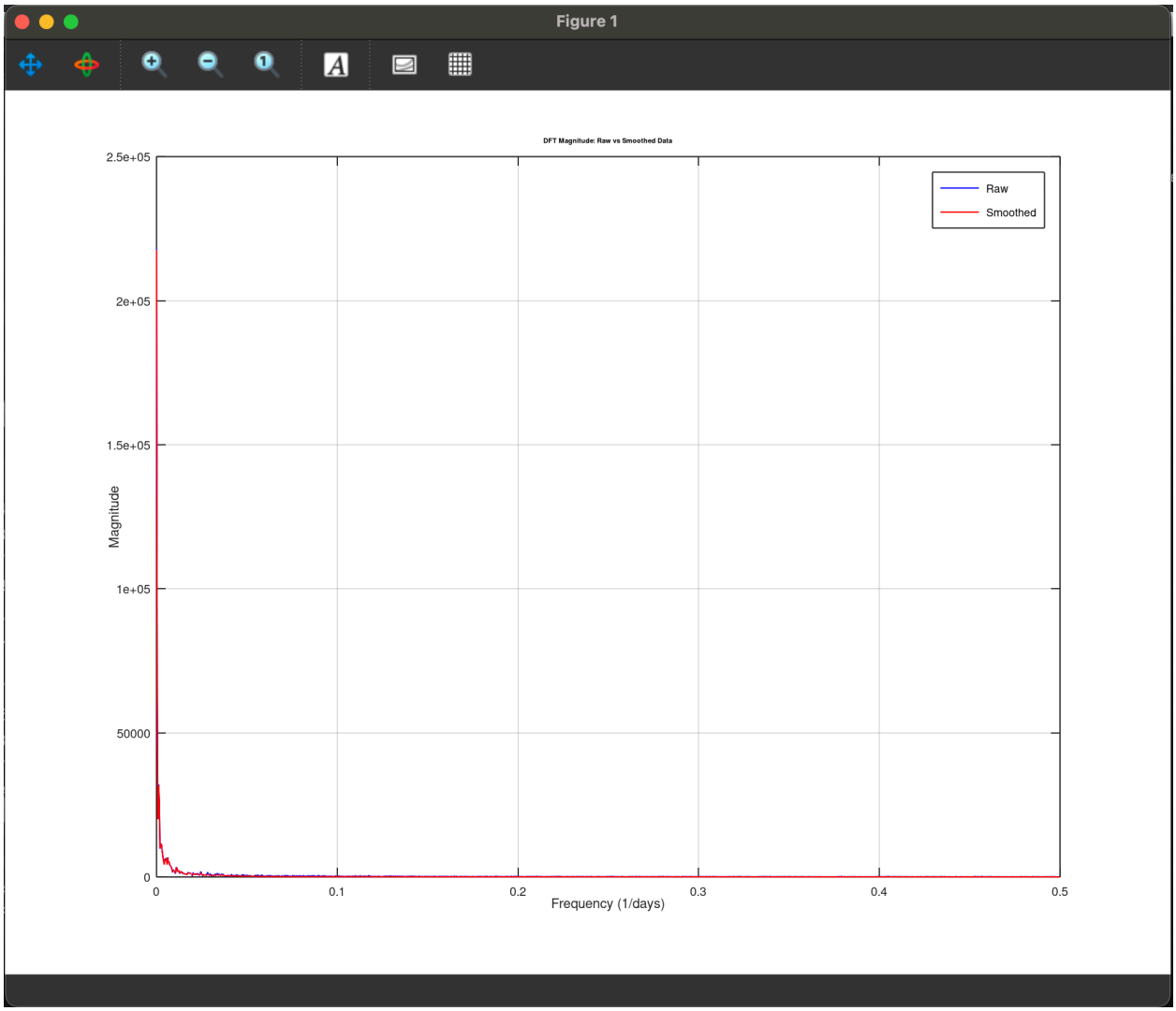
Octave Code:

```
Y_filtered = fft(smoothed_prices);
mag_filtered = abs(Y_filtered);
mag_filtered = mag_filtered(1:floor(N/2));

figure;
plot(f, magnitude, 'b'); hold on;
plot(f, mag_filtered, 'r');
xlabel('Frequency (1/days)');
```

```
ylabel('Magnitude');
title('DFT Magnitude: Raw vs Smoothed Data');
legend('Raw', 'Smoothed');
grid on;
```

Plot:



The result makes sense because the smoothed DFT shows lower magnitudes at high frequencies, indicating reduced noise and short-term fluctuations. This matches the expected effect of a running average filter, which acts as a low-pass filter in this case.