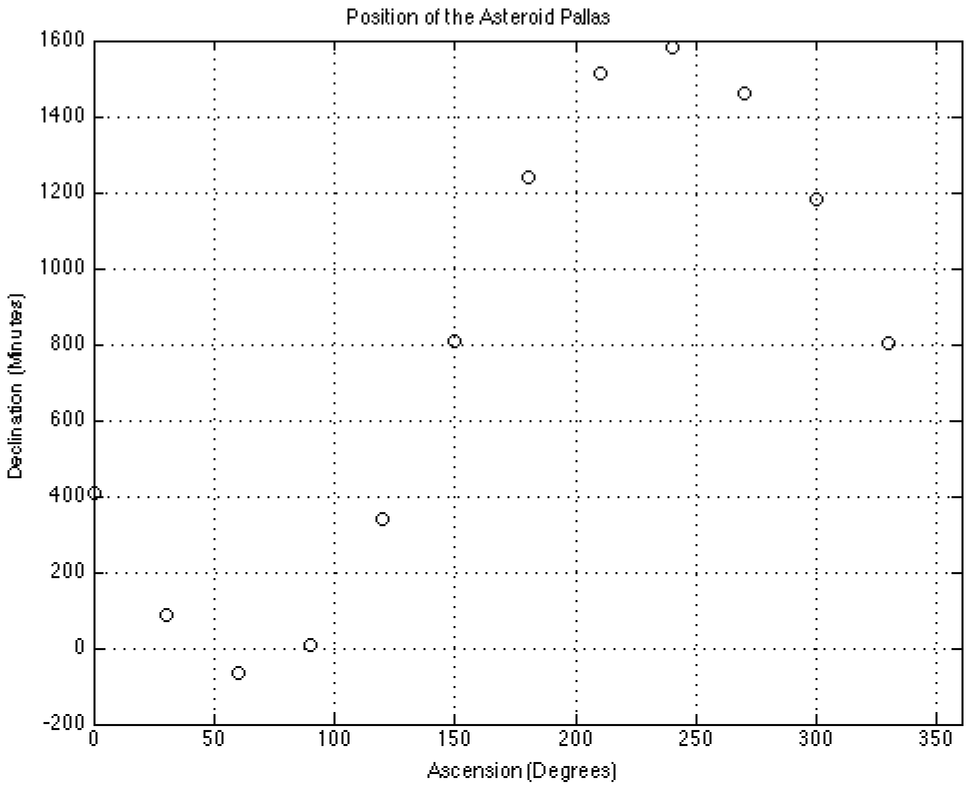
Gauss was interested in the problem of computing accurate

asteroid orbits from observations of their positions. His paper contains 12 data points on the position of the asteroid Pallas, through which he wished to interpolate a trigonometric polynomial with 12 coefficients. Instead of solving the resulting 12-by-12 system of linear equations by hand, Gauss looked for a shortcut. He discovered how to separate the equations into three subproblems that were much easier to solve, and then how to recombine the solutions to obtain the desired result. The solution is equivalent to estimating the DFT of the data with an FFT algorithm.

Contents

Here is the data that appears in Gauss' paper:

```
asc = 0:30:330;
dec = [408 89 -66 10 338 807 1238 1511 1583 1462 1183 804];

figure(1)
plot(asc,dec,'ok')
xlim([0 360])
xlabel('Ascension (Degrees)')
ylabel('Declination (Minutes)')
title('{\bf Position of the Asteroid Pallas}')
grid on
```

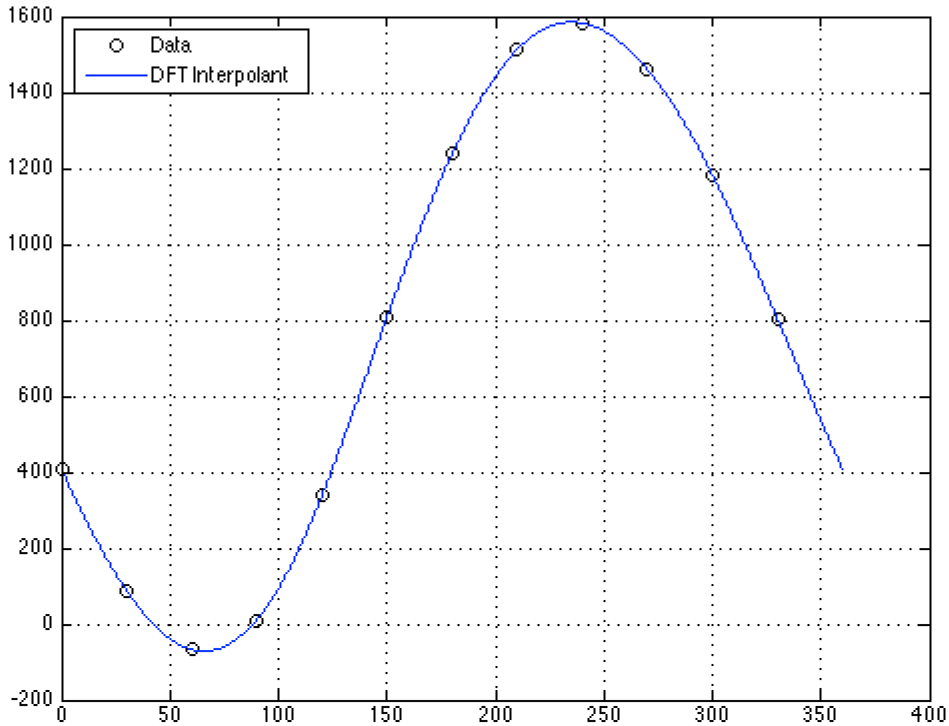


The following uses fft to perform an equivalent of Gauss' calculation:

```
d = fft(dec);
m = length(dec);
M = floor((m+1)/2);

a0 = d(1)/m;
an = 2*real(d(2:M))/m;
a6 = d(M+1)/m;
bn = -2*imag(d(2:M))/m;
```

Plot the interpolant with the data:

```
% hold on

x = 0:0.01:360;
n = 1:length(an);
y = a0 + an*cos(2*pi*n'*x/360) ...
    + bn*sin(2*pi*n'*x/360) ...
    + a6*cos(2*pi*6*x/360);

figure(2)
plot(asc,dec,'ok',x,y,'Linewidth',1)
legend('Data','DFT Interpolant','Location','NW')
grid on
```



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