

Problem Set 8: Fourier transforms via FFTs and MMTs

1. See Figure 1.

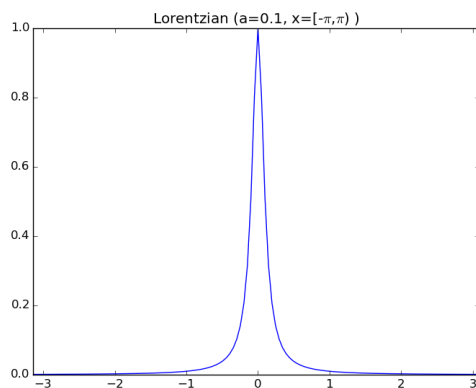


Fig. 1.—

2. Done.
3. As shown in Figure 2, power spectra from the MMT and the FFT are essentially identical, with slightly increased error at higher frequencies.

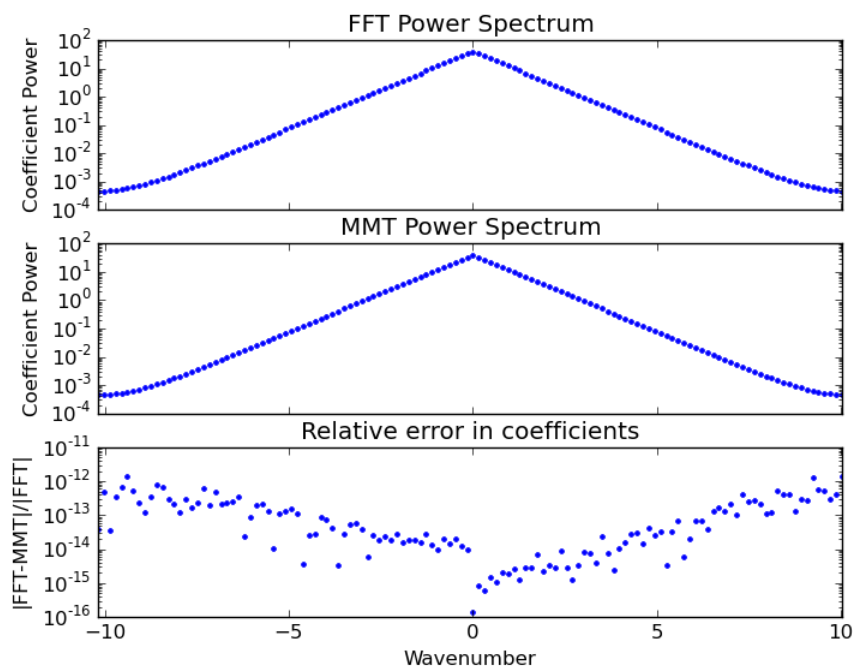


Fig. 2.—

4. The Lorentzian produced using the inverted MMT is virtually identical, as shown in the second plot in Figure 3. The top plot shows this similarity, with the inverted plot offset vertically to allow visual comparison.

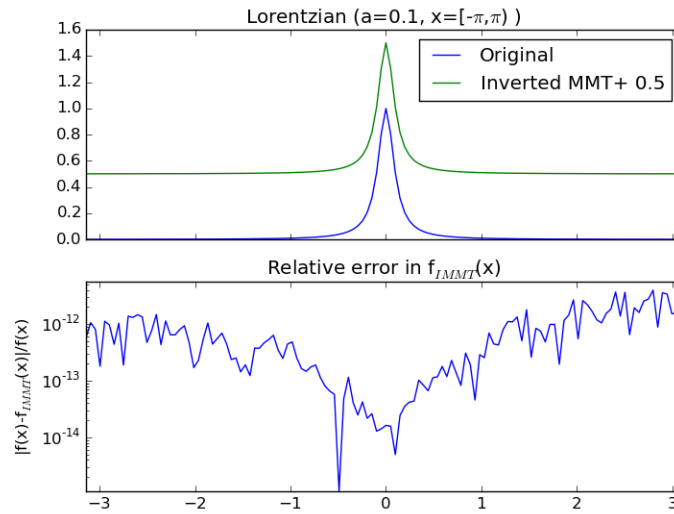


Fig. 3.—

5. For very low sample sizes, the MMT beats out the FFT, but generally the FFT will always win for sample sizes that are powers of 2, and the amount of lag it picks up over time grows more slowly than that of the MMT, as shown in Figure 4

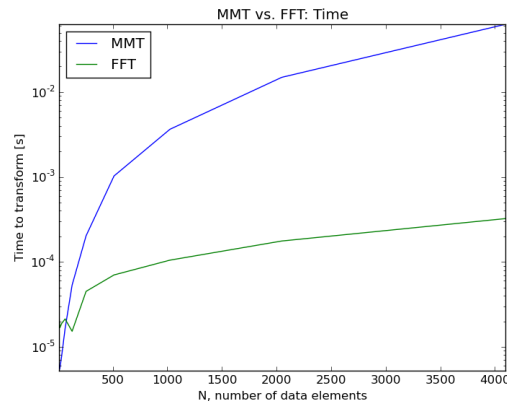


Fig. 4.—

6. As shown in Table 1, changing to a sample size that was not a power of 2 led to the FFT taking a much more similar amount of time to the MMT, dropping to only being about 6 times faster.

N	t_{MMT} (s)	t_{FFT} (s)	t_{MMT}/t_{FFT}
2048	$1.4912 \cdot 10^{-2}$	$1.7643 \cdot 10^{-4}$	84.519
2049	$1.5039 \cdot 10^{-2}$	$2.5755 \cdot 10^{-3}$	5.8393

Table 1:

Code used in this assignment can be found at https://github.com/brbordwell/ASTR_5540/HW8