SDR-Boston

Boston SDR User Group

NEWSDR'11

A Historical Perspective on Software Radio

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EDWIN H. ARMSTRONG
1890 - 1954

Patent
1,342,88
5

E. H. ARMSTRONG.
METHOD OF RECEIVING HIGH FREQUENCY OSCILLATIONS.
APPLICATION FILED FEB. 8, 1919.

Patented June 8, 1920.

Fig. 1,

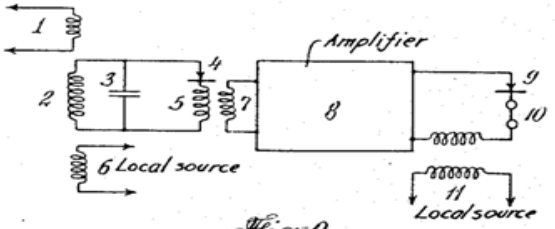


Fig. 2,

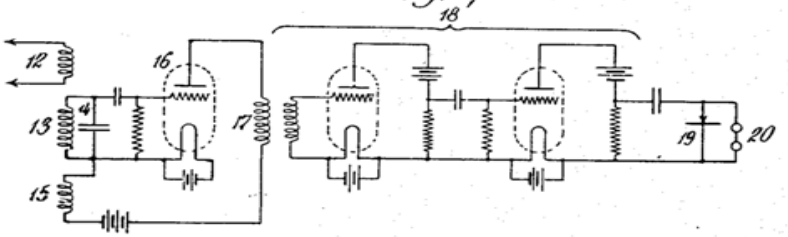


Fig. 3,

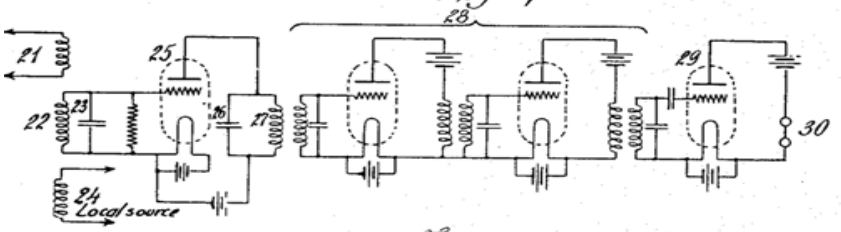
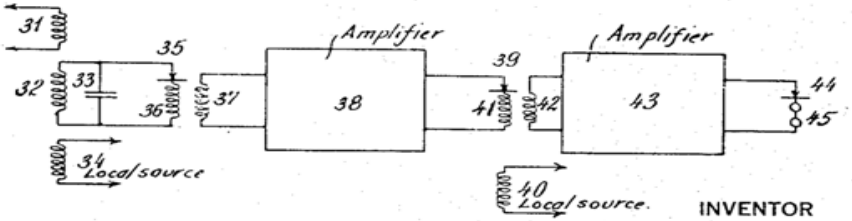
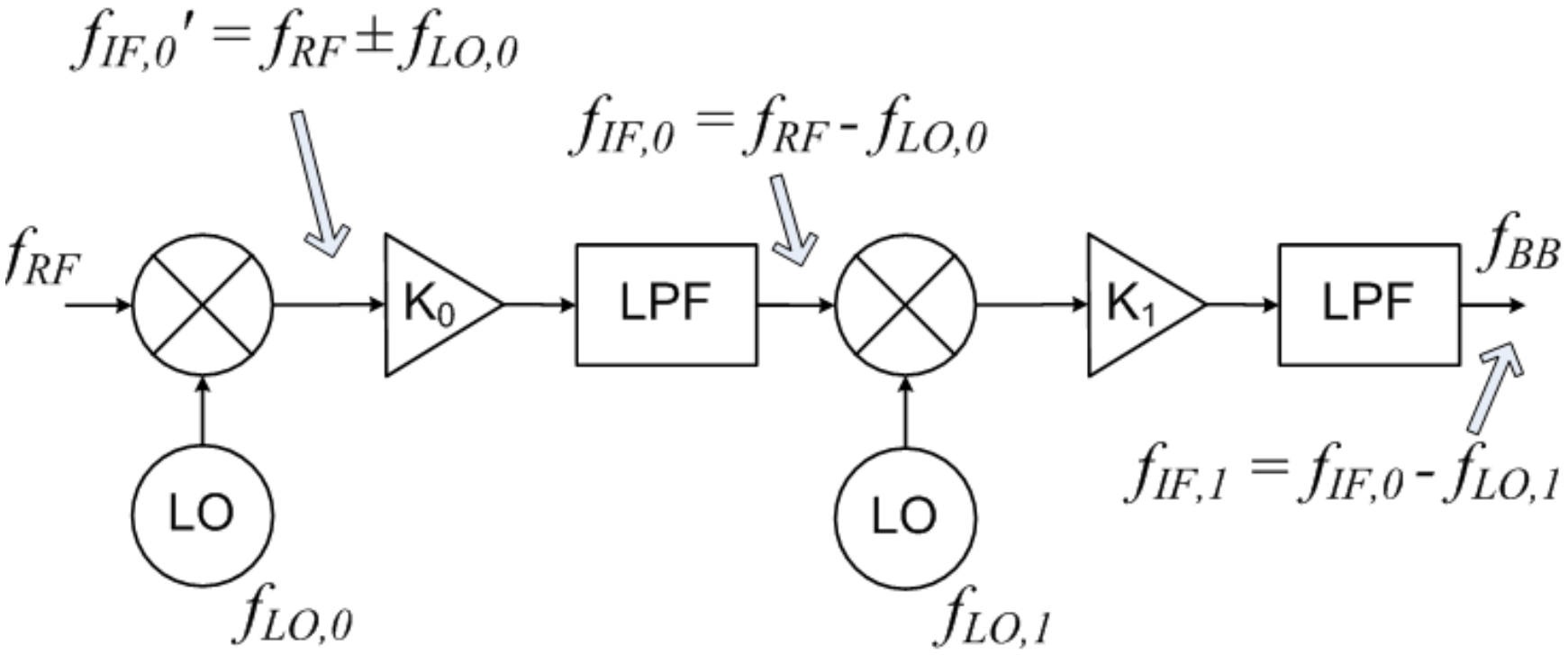


Fig. 4,



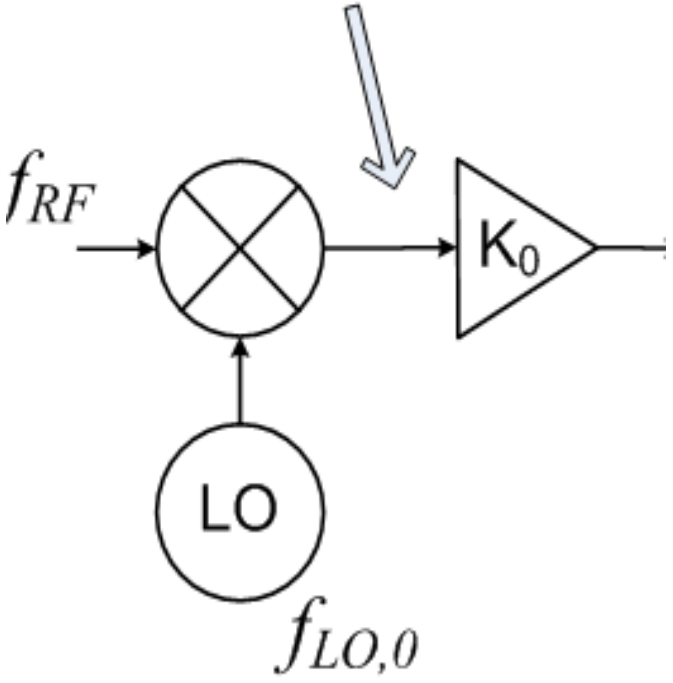
INVENTOR
Edwin H. Armstrong
BY
Pennie, Davis, Marvin & Edmonds
ATTORNEYS

The Superhet



Analog Mixing ≠ Multiplication

$$f_{IF,0}' = f_{RF} \pm f_{LO,0}$$



$$f_{IF,0}' = Mf_{RF} \pm Nf_{LO,0}$$

Theory

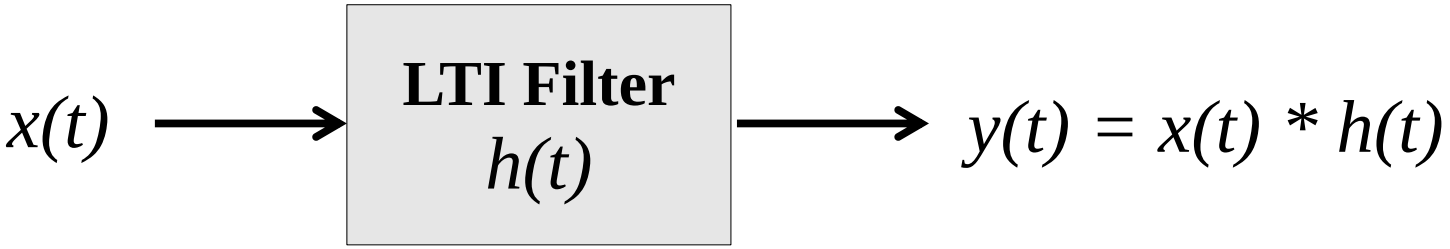
$$f_{IF,0}' = f_{RF} - f_{LO,0}$$

$$y(t) = x(t)Re\{exp(-j2\pi f_{LO,0}t)\}$$

$$f_{IF,0}' = Mf_{RF} \pm Nf_{LO,0}$$

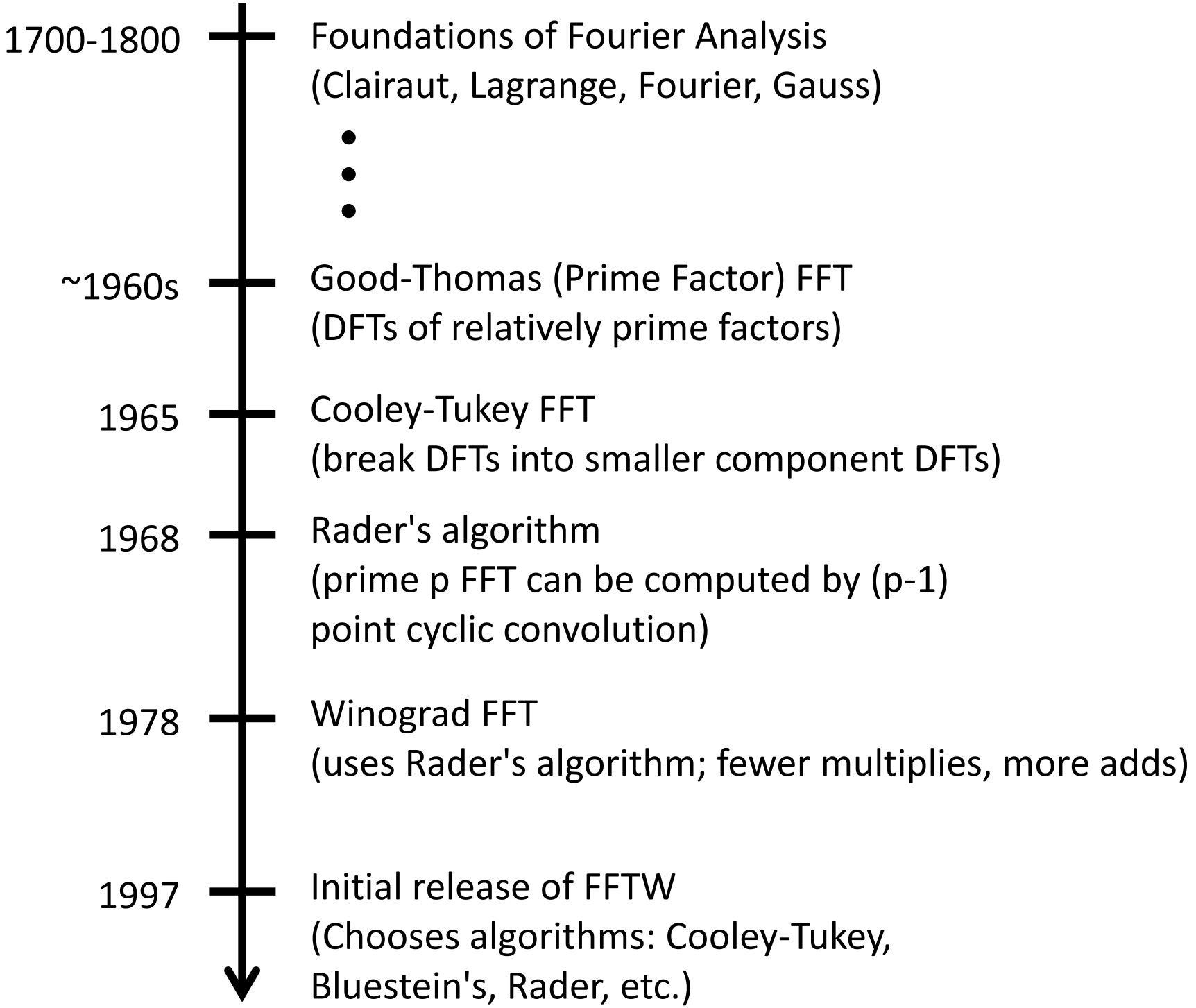
Implementation

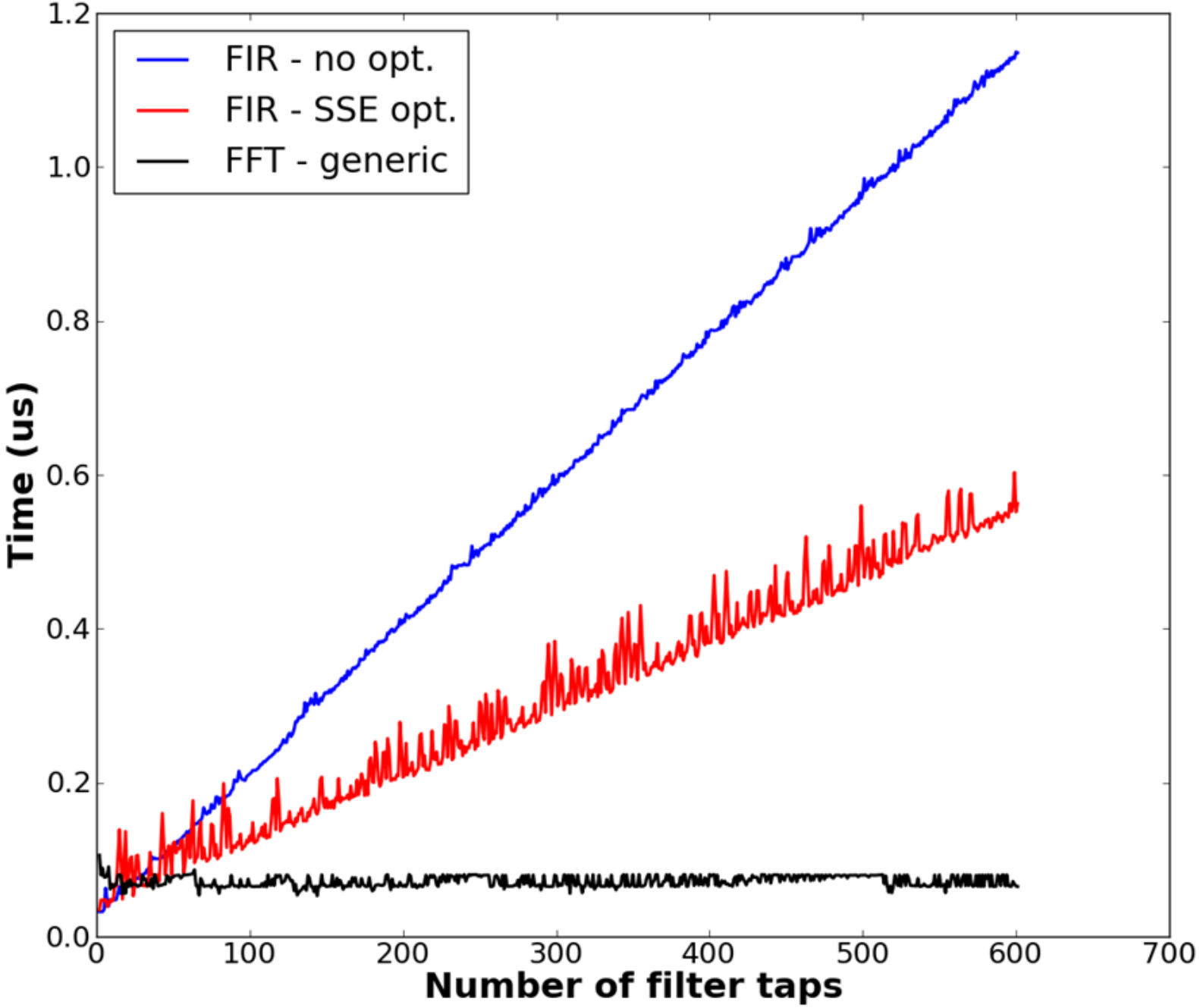
$$F(f) = \int_{-\infty}^{\infty} f(x) e^{-j2\pi x f} \, df$$



Convolution Theorem

$$y(t) = x(t) * h(t) \leftrightarrow Y(f) = X(f) \cdot H(f)$$


1700-1800
Foundations of Fourier Analysis
(Clairaut, Lagrange, Fourier, Gauss)
~1960s
Good-Thomas (Prime Factor) FFT
(DFTs of relatively prime factors)
1965
Cooley-Tukey FFT
(break DFTs into smaller component DFTs)
1968
Rader's algorithm
(prime p FFT can be computed by (p-1)
point cyclic convolution)
1978
Winograd FFT
(uses Rader's algorithm; fewer multiplies, more adds)
1997
Initial release of FFTW
(Chooses algorithms: Cooley-Tukey,
Bluestein's, Rader, etc.)


FIR - no opt.
FIR - SSE opt.
FFT - generic
Time (us)
Number of filter taps
0.0
0.2
0.4
0.6
0.8
1.0
1.2
0
100
200
300
400
500
600
700