$(\nu N) \times (\nu N)$ matrix, where ν is an oversampling factor. The third step is a modification (or correction) step which involves multiplying values at each frequency by a precomputed factor. At this step we effectively generate a representation involving the Battle–Lemarié scaling function [10, 1].

[2] The fact that such an approach may be used has also been recognized by Coifman [13].

discussed in Section IX where we also briefly discuss applications of these algorithms in numerical analysis and signal processing.

II. PRELIMINARY CONSIDERATIONS

As an example let us consider the problem of computing

$$\hat{f}(m) = \int_0^1 f(x) e^{-2\pi i m x}\, dx \tag{2.1}$$

and ¯ denotes the complex conjugate. Replacing the integral

ported in the Fourier domain and is given by where $\bar{\varphi}$ is given in (2.18). This implies that by comput-

Let us summarize our results as

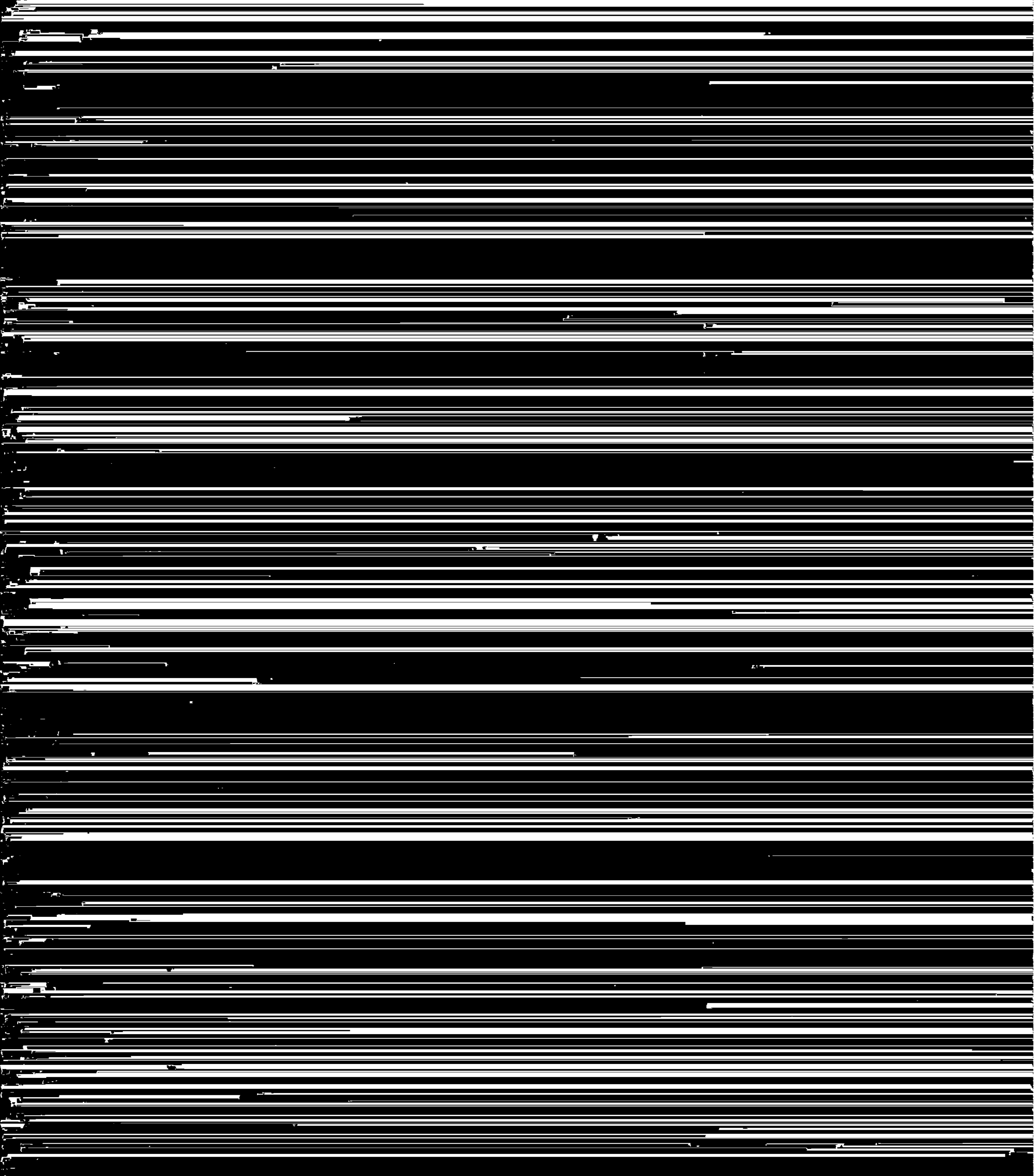

FIG. 1 The Fourier transform of Battle–Lemarié scaling function of order $m = 23$. Shown are functions $\varphi^{(m)}(\xi)$, $\varphi^{(m)}(\xi + 1)$ and $\varphi^{(m)}(\xi - 1)$.

where $x_l \in [0, 1]$ and $\{g_l\}_{l=0}^{N_p-1}$ is a set of N_p complex numbers. Indeed, we may replace (4.1) by the integral

$$\hat{g}_n = \hat{f}(n) = \frac{1}{N^{1/2}\sqrt{a^{(m)}(n/N)}} \sum_{k=0} f_k e^{-2\pi i k n/N}, \quad (4.7)$$

$$w_k = \begin{cases} f_{k+N/2} & \text{for } -N/2 \leqslant k \leqslant N/2 - 1 \\ 0 & \text{otherwise} \end{cases} \tag{6.4}$$

dimensions is straightforward and we outline it below for two independent variables. We seek a fast algorithm to evaluate

The steps of the interpolation algorithm in the case of two independent variables are in the reverse order as compared to the steps of the algorithm in Section V and, therefore, the interpolation algorithm has the same computational complexity as USFFT algorithm in Section V.

where $\varphi_{kj}^{(m)}(x) = 2^{-j/2}\varphi^{(m)}(2^{-j}x - k)$ and

$$f_k^o = \int_{-\infty}^{\infty} f(x)\varphi_{kj}^{(m)}(x)\,dx. \qquad (7.6)$$

512	3.60	52.22	0.81	56.63	8.3e-16	11.45	20,605

times but the location of points does not change, then the

32768	0.144	0.743	0.887	0.274

$2^{[illegible]} \times 2^{[illegible]}$	$1.1 \times 10^{[illegible]}$	$5.0 \times 10^{[illegible]}$
$2^{10} \times 2^{10}$	2.1×10^{-13}	9.7×10^{-14}

$2^{[illegible]} \times 2^{[illegible]}$	$3.9 \times 10^{[illegible]}$	$2.5 \times 10^{[illegible]}$
$2^{10} \times 2^{10}$	7.9×10^{-5}	4.9×10^{-5}

$N_{\mathrm{freq}} = N_p$.

$\hat{\beta}^{(m)}(\xi)$

$$\hat{\varphi}^{(m)}(\alpha) = \inf_{|\xi|\leq\alpha} |\hat{\varphi}^{(m)}(\xi)|, \qquad (10.9)$$

then we obtain from (10.5)

It is sufficient to consider $\xi \in (0,1)$ since $\hat{\varphi}^{(m)}(\xi)$ is symmetric around $\xi = 0$. We obtain from (3.3)

$k\in\mathbf{Z}$ $l=0$ $m\in\mathbf{Z}$

periodically.

Applications" (C. Chui, Ed.), pp. 91–122. Academic Press, San Diego, 1992.