A 3-D Sparse FIR Frustum Filter for Enhancing Broadband Plane Waves - Supplementary Results

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I. Introduction

This is the supplementary results and MATLAB source code repository for our paper titled "A 3-D Sparse FIR Frustum Filter for Enhancing Broadband Plane Waves".

II. Reduction of computational complexity

The Figures 1, 2, 3 and 4 show the computational complexity savings in terms of the complex multipliers and complex adders in using our spatial interpolation technique versus the conventional windowing method. Here, the interpolation factor M and the hard-thresholding factor h_{th} is varied to verify their effects on computational complexity reduction.

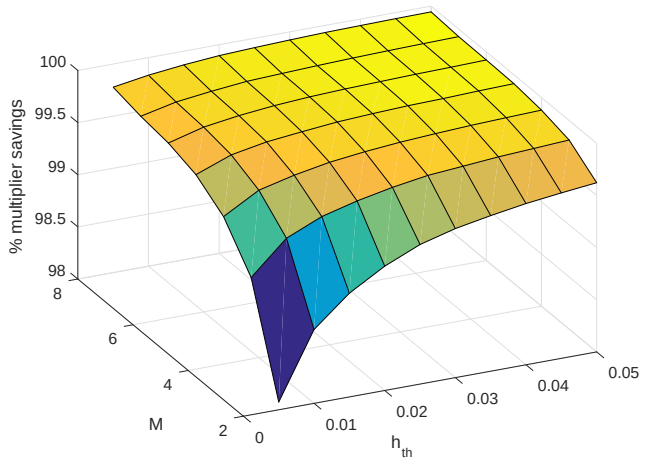

Fig. 1. Percentage complex multiplier savings from conventional frustum filter to proposed spatially interpolated filter.

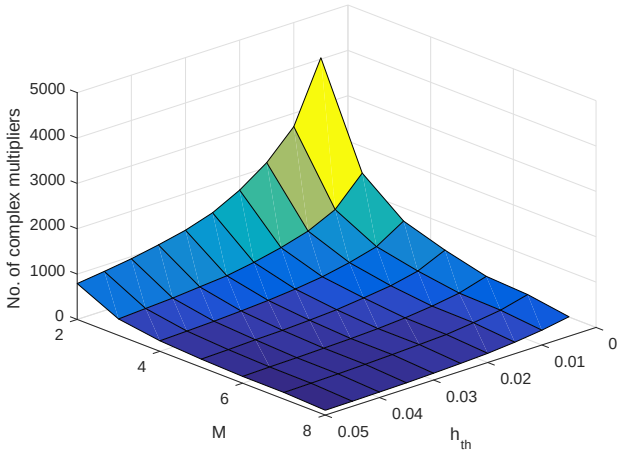

Fig. 2. Total complex multipliers required to implement the spatially interpolated frustum filter.

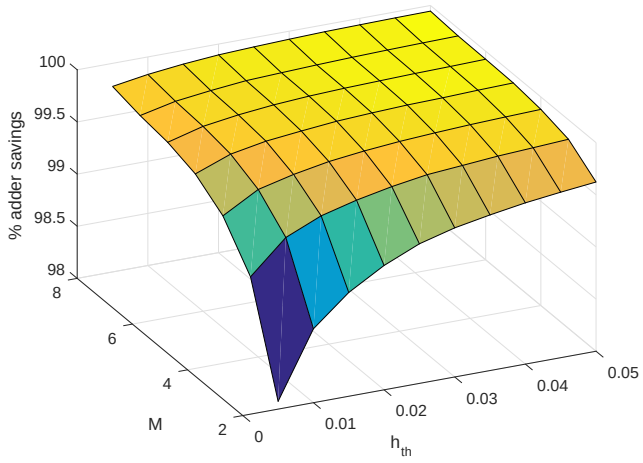

Fig. 3. Percentage complex adder savings from conventional frustum filter to proposed spatially interpolated filter.

III. Distortion of the Filter

The Figures and detail the distortion from the conventional filter resulting from interpolation, masking and hard-thresholding carried out when designing the filter cascade. In order to numerically evaluate the distortion, the normalized root mean square error (NRMSE) of the interpolated filter $H(z)$ is compared to the conventional filter $H_{conv}(z)$,

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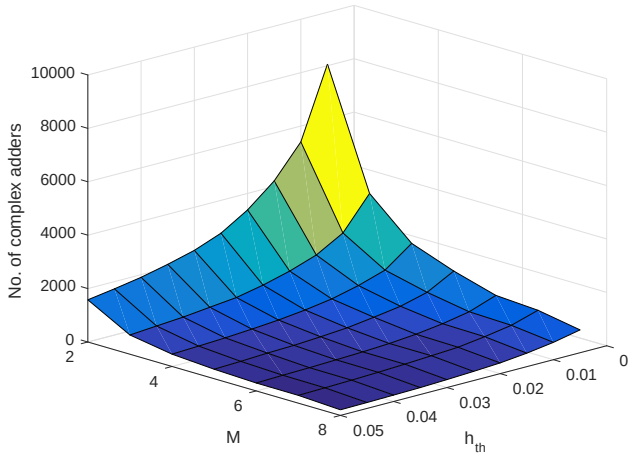

Fig. 4. Total complex adders required to implement the spatially interpolated frustum filter.

$$\text{NRMSE} = \frac{\|H(\mathbf{n}) - H_{conv}(\mathbf{n})\|_2}{\sqrt{F_x F_y F_{ct}}\,\{\max(|H(\mathbf{n})|) - \min(|H(\mathbf{n})|)\}},$$

where $\|\cdot\|_2$ denotes the 2-norm of a tensor, F_x, F_y, F_{ct} are FFT lengths in their respective dimensions, and $\mathbf{n} = (n_x, n_y, n_{ct})$.

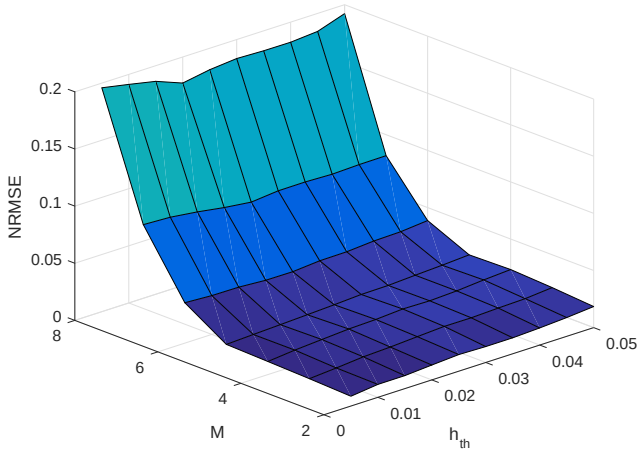

Fig. 5. NRMSE between the proposed filter and the equivalent conventional filter.