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Image anti-aliasing techniques for Internet visual media processing: a review

Key words: Anti-aliasing, Hardware, Post-filtering, Pre-filtering, Sampling

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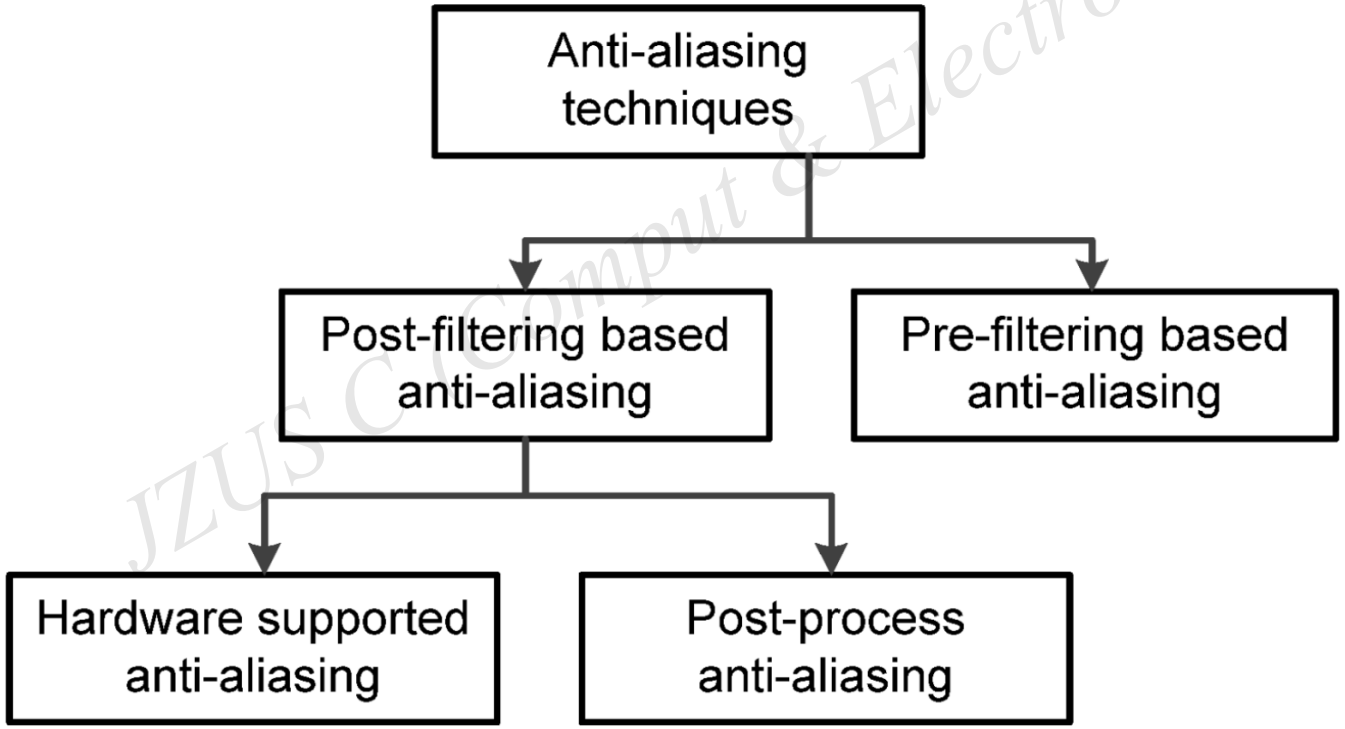
Motivation

- A number of anti-aliasing techniques have been proposed in recent years. A survey along this direction is important and timely.

- We present a comprehensive overview of the anti-aliasing techniques by classifying them into two categories: *post-filtering* based anti-aliasing and *pre-filtering* based anti-aliasing.

Overview

A high level view of the anti-aliasing techniques:



Post-filtering based anti-aliasing

We discuss major post-filtering based anti-aliasing techniques and compare them from various aspects:

Anti-aliasing method	Depth	Coverage	Geometry	Shading values	Storage	Bandwidth
No anti-aliasing	Once	N/A	Once	Once	Once	Once
SSAA	All	N/A	Once	Once	All	All
MSAA, CSAA, EQAA	Many	Many	Once	Once	Many	Some
MLAA, FXAA, SMAA 1x	Once	N/A	Once	Once	Some	Some
CFAA	N/A	Many	Once	Once	Many	Some
Geometric methods	N/A	N/A	∞	Once	Some	Some
DLAA	Once	N/A	Once	Once	Some	Some
SMAA 4x	Some	N/A	Some	Some	Some	Some
SRAA	Many	N/A	Many	Some	Many	Many
SBAA	Many	Many	Many	Once	Some	Some
RSAA	Many	Many	Many	Once	Some	Some

Pre-filtering based anti-aliasing

- The techniques change the spectrum of the input signal by attenuating all of the high-frequency components before sampling at pixel rates.

- Most research in this field has focused on three areas: (1) a closed-form solution to support arbitrary filter kernels; (2) highly effective integral computation; and (3) expansion of the filter functions.

Comparison of anti-aliasing techniques

High-level comparison of anti-aliasing techniques:

Anti-aliasing category	Anti-aliasing quality	Performance	Input restriction	Bandwidth
Hardware methods	Low	High	None	High
Post-processing methods	Medium	Medium	None	Low
Pre-filtering-based methods	High	Low	Analytic	Low

Conclusions

- Anti-aliasing techniques take advantage of increased bandwidth and computation on future GPUs.
- A research direction could be to integrate heuristic shading weights with accurate geometric weights for higher quality by combining ideas from hardware and the morphological anti-aliasing (MLAA) family.
- Further implementations could absorb the essence from pre- and post-filtering to construct approaches to achieve fine aliased images.