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The SAGE
Graphics Architecture

Michael Deering
David Naegle

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XVR-4000
The **SAGE**
Graphics Architecture

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XVR-4000:
A Scalable, Advanced Graphics
Engine

XVR-4000 is intended for High-end
applications

- Photorealistic Virtual Prototyping
- Scientific Visualization
- Simulation & Training
- Volume Visualization

Trends in Graphics
Acceleration Hardware
for High-End Visualization



High-End Data Display is Increasing in
Sophistication

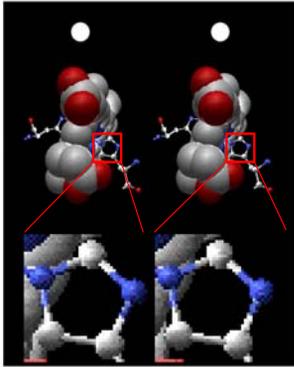
Fewer Manufacturers are Designing
Graphics Chipsets for the High End

Attempts to satisfy the High End by
Clustering Commodity Graphics Chips

A Typical Installation

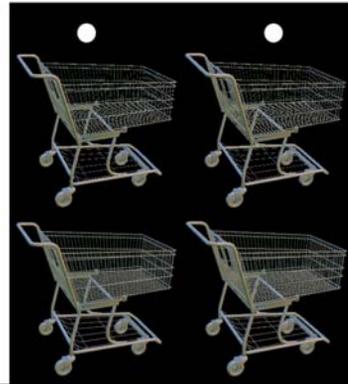


Stereo Pair, Crossed Eye View



Uncorrelated jaggies in right & left eye views interfere with high fidelity stereo fusion

Stereo Pair, Crossed Eye View



Growing Disparity between Graphics and Display Technology



- Graphics Rendering Power is on a much higher growth curve than Display devices.
- Display Devices are Doubling in Resolution every Decade.
- Opportunity: Use Silicon to improve the effective Display Resolution.

Anti-aliasing: Software



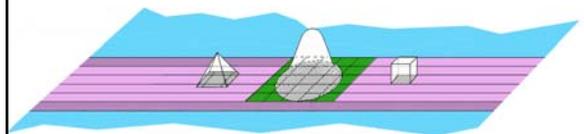
- Long, rich history
- Far from realtime
- Stochastically perturbed grid of image samples
- Large, bicubic filter kernels, often with negative side-lobes

Anti-aliasing: Hardware

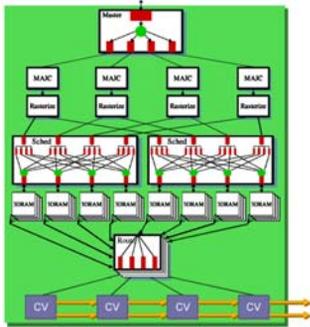


- Multi-pass, high image quality, 10x - 50x slower than full speed
 - Accumulation Buffering
- Full speed, lower image quality
 - BSP-sorted Rendering with Edge Blending (Early flight simulators and some games)
 - Single Pixel, Box Filter (Most current hardware)
 - Simple Tent Filter (Latest Game chips)

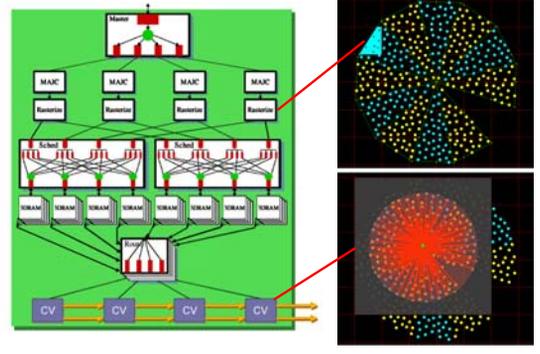
Comparison of XVR-4000 Filters to Previous Realtime Hardware Filters



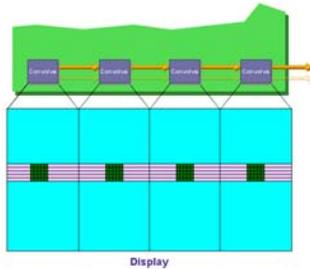
XVR-4000 Block Diagram



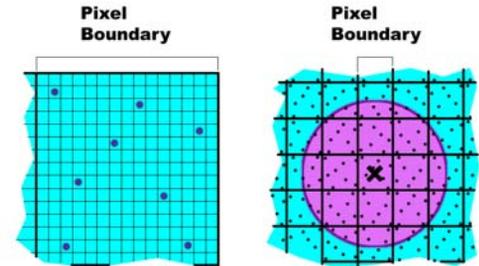
Rasterizer & Convolver mutually agree on samples' sub-pixel locations



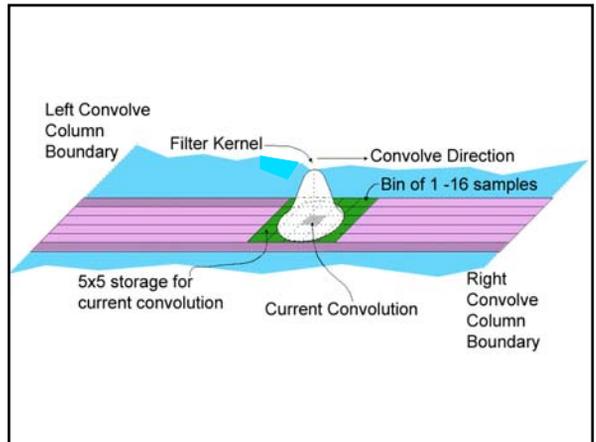
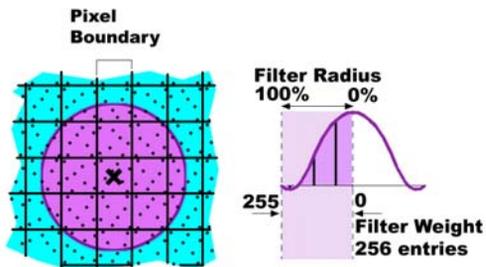
Each Convolve ASIC owns a column of the screen



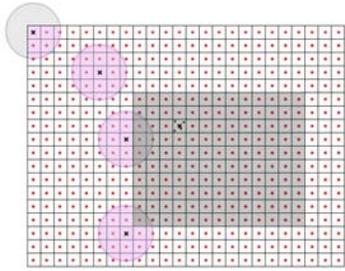
1 to 16 RGBA samples are placed on a 64x64 grid within a pixel. Adjacent pixels' sample locations are not the same as in neighboring pixels.



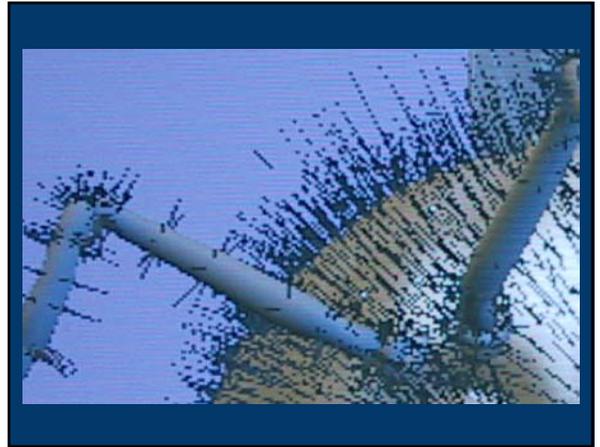
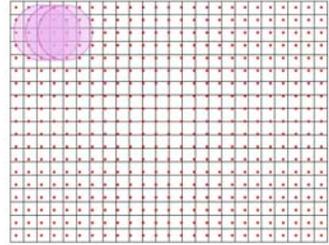
Convolution Kernel Shape is specified by a table. Filter radius is also programmable, $0.707 \geq R \geq 2.5$.

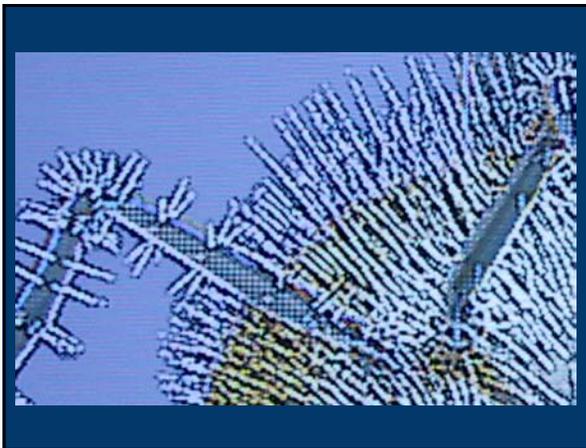


On-the-fly normalization is required for XVR-4000 antialiasing. Bonus: The colored areas of all these kernels are unit-volume because of normalization.



Video Resizing: Magnification





Show Video

Acknowledgements

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The End