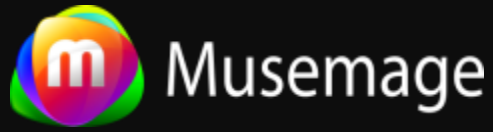


Musemage

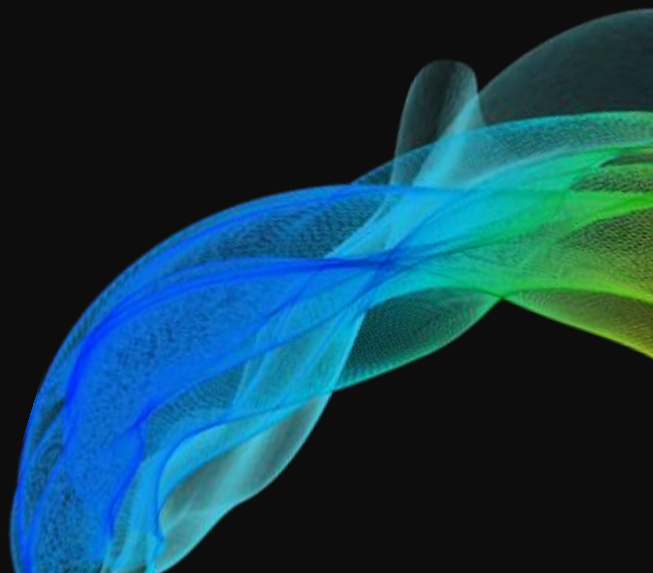
The Revolution of Image Processing

Kaiyong Zhao – Hong Kong Baptist University, Paraken Technology Co. Ltd.
Yubo Zhang – University of California Davis

Paraken 平行视野

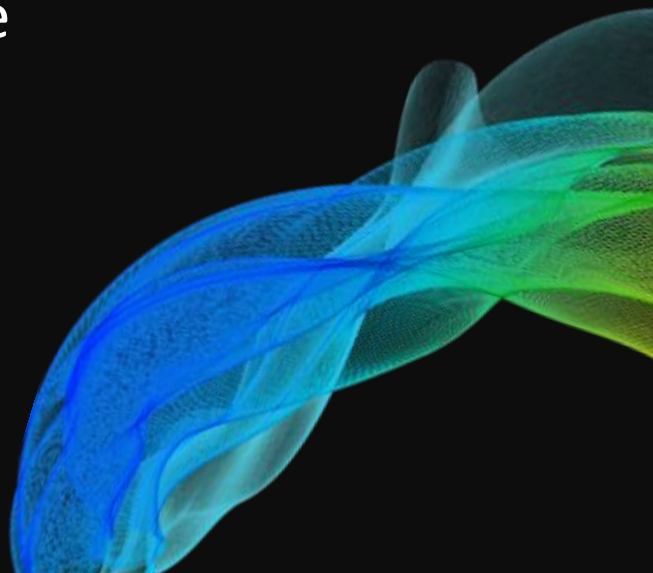
Outline

- Introduction of Musemage
- Why GPU based
- Musemage Features
- Musemage Framework
- Background & Future Works



What is Musemage?

- The first comprehensive image processing software fundamentally based on GPU.
- Ultra-fast image processing experience
- Rich and easy-to-use functions
- Friendly user interfaces



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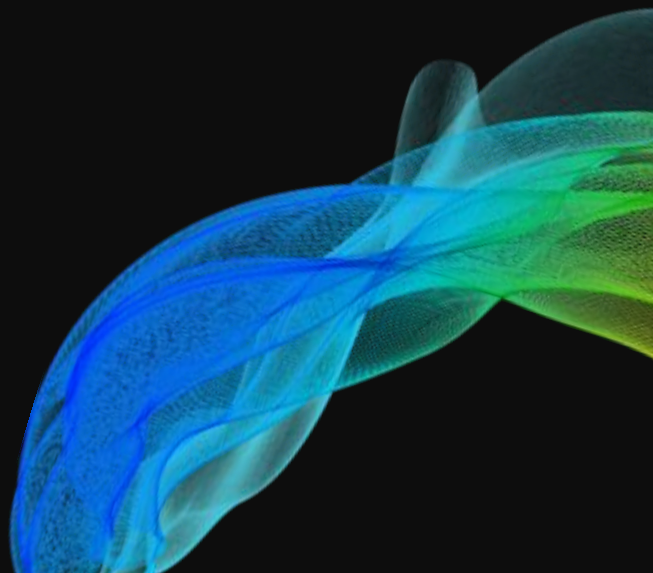
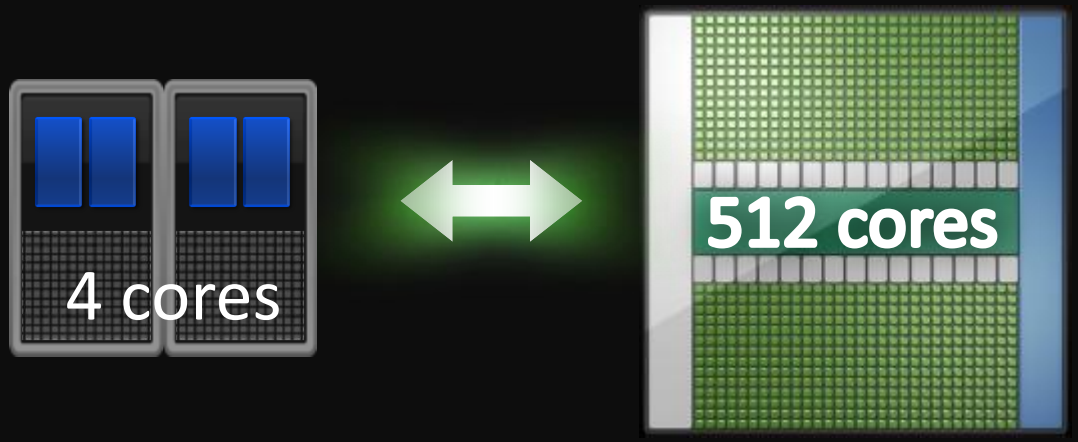
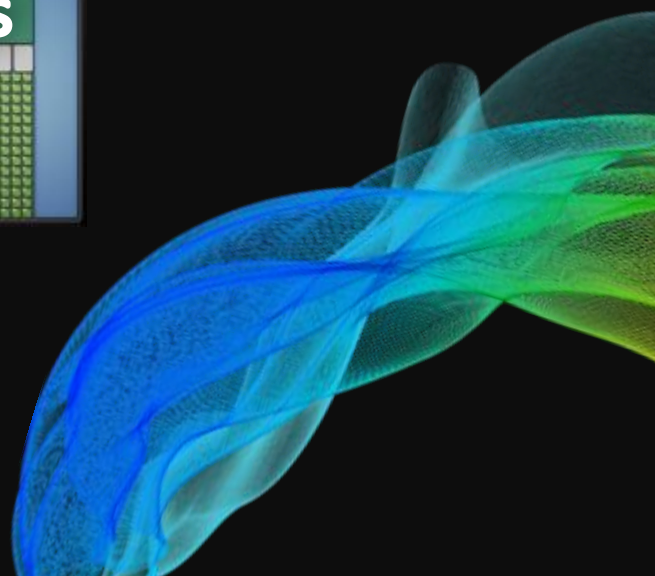


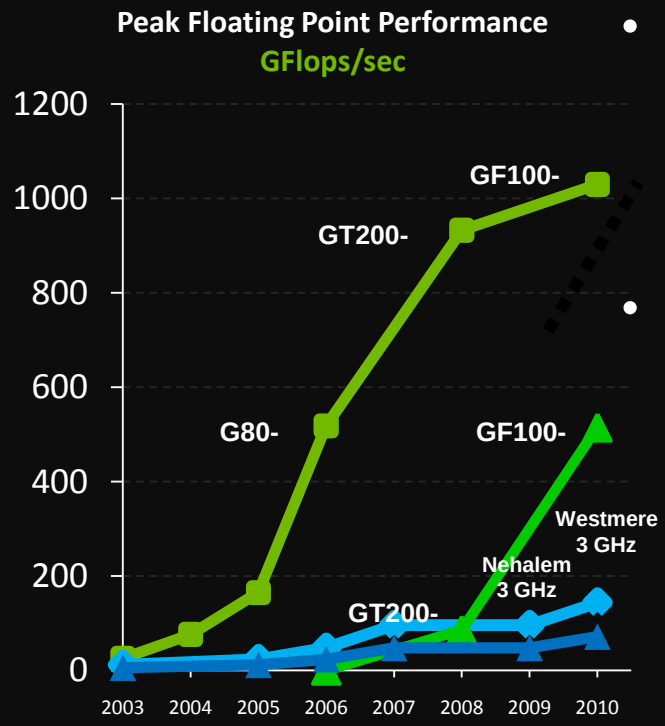
Why Musemage uses GPU?



CPU + GPU co-processing



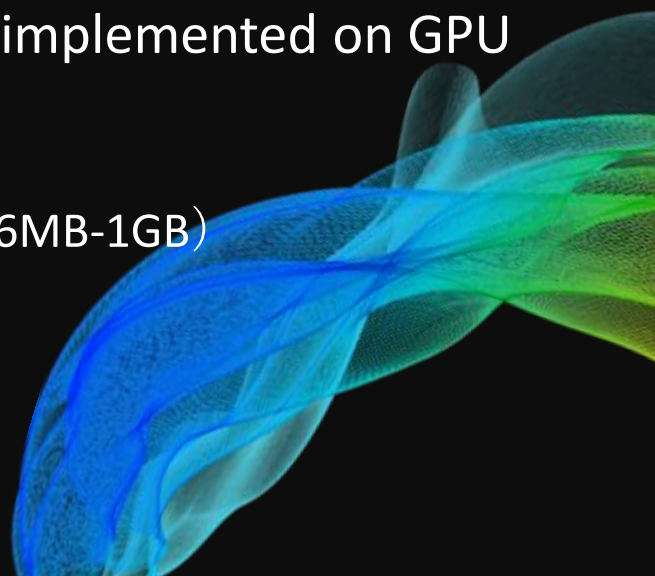
Why Musemage uses GPU?



- GPU has massive compute power
  - SP peak performance of Fermi GPU more than 1T flops/s
  - GPU compute power is growing faster
  - GPU has much higher memory bandwidth (10X CPU)
- The architecture of GPU is designed for 3D graphics processing
  - Image processing in a sense is similar to 3D graphics
  - High precision (fp32) compute power is free on GPU
  - Programmability of GPU dramatically improved in past 3 years, complicated shaders enable advanced filters

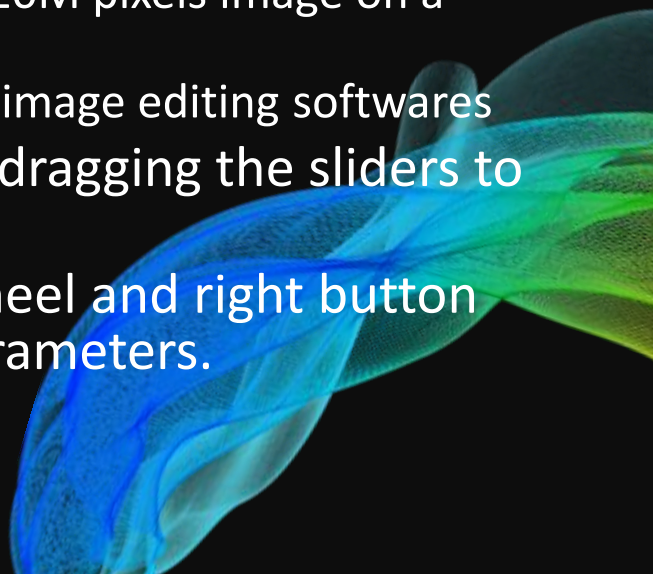
What are the difficulties?

- Memory management is more complicated
  - Need to manage 3 levels of memory（GPU mem, host mem, HDD buffer）
  - Hide the data transmission delay
  - Efficient undo/redo
- Many image processing algorithms are rarely implemented on GPU
- GPU memory is limited
  - Image processing needs large memory
  - Memory size of main stream GPU is limited（256MB-1GB）
- Issues raised by GPU’s graphics characters
  - Driver timeout



What GPU brings for Musemage?

- Because all adjustment tools and filters of Musemage are implemented on GPU, it can provide:
  - High processing speed
    - It takes less than one second when filtering 20M pixels image on a commodity GPU
    - Some filters are 15-100x faster than existing image editing softwares
  - Real-time full screen feedback when user dragging the sliders to adjust parameters.
  - Zooming and moving canvas by mouse wheel and right button at any time, even while adjusting filter parameters.



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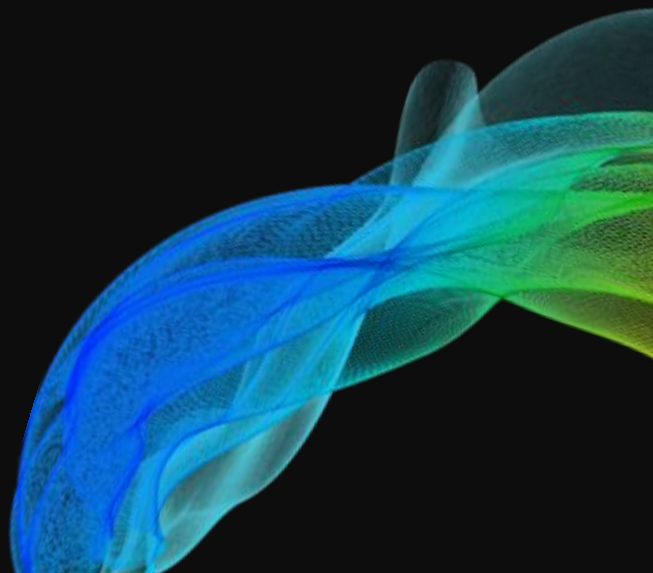
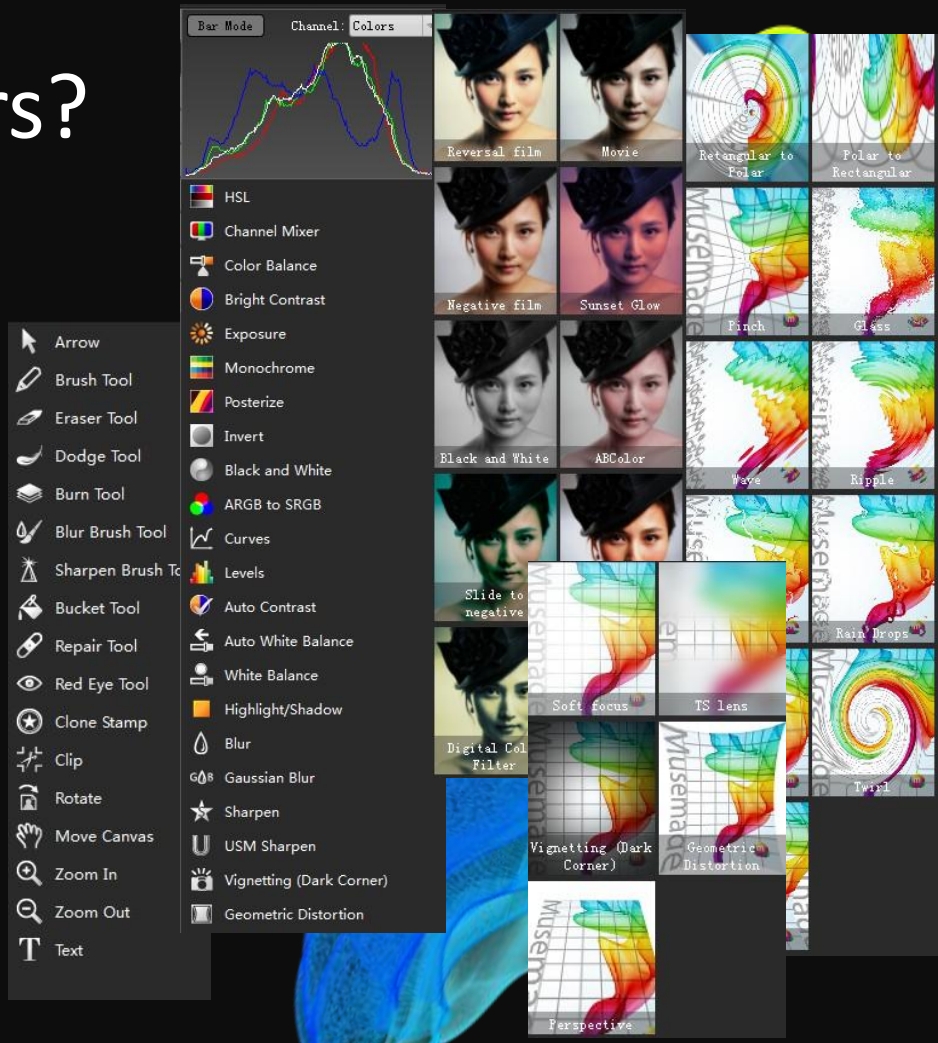
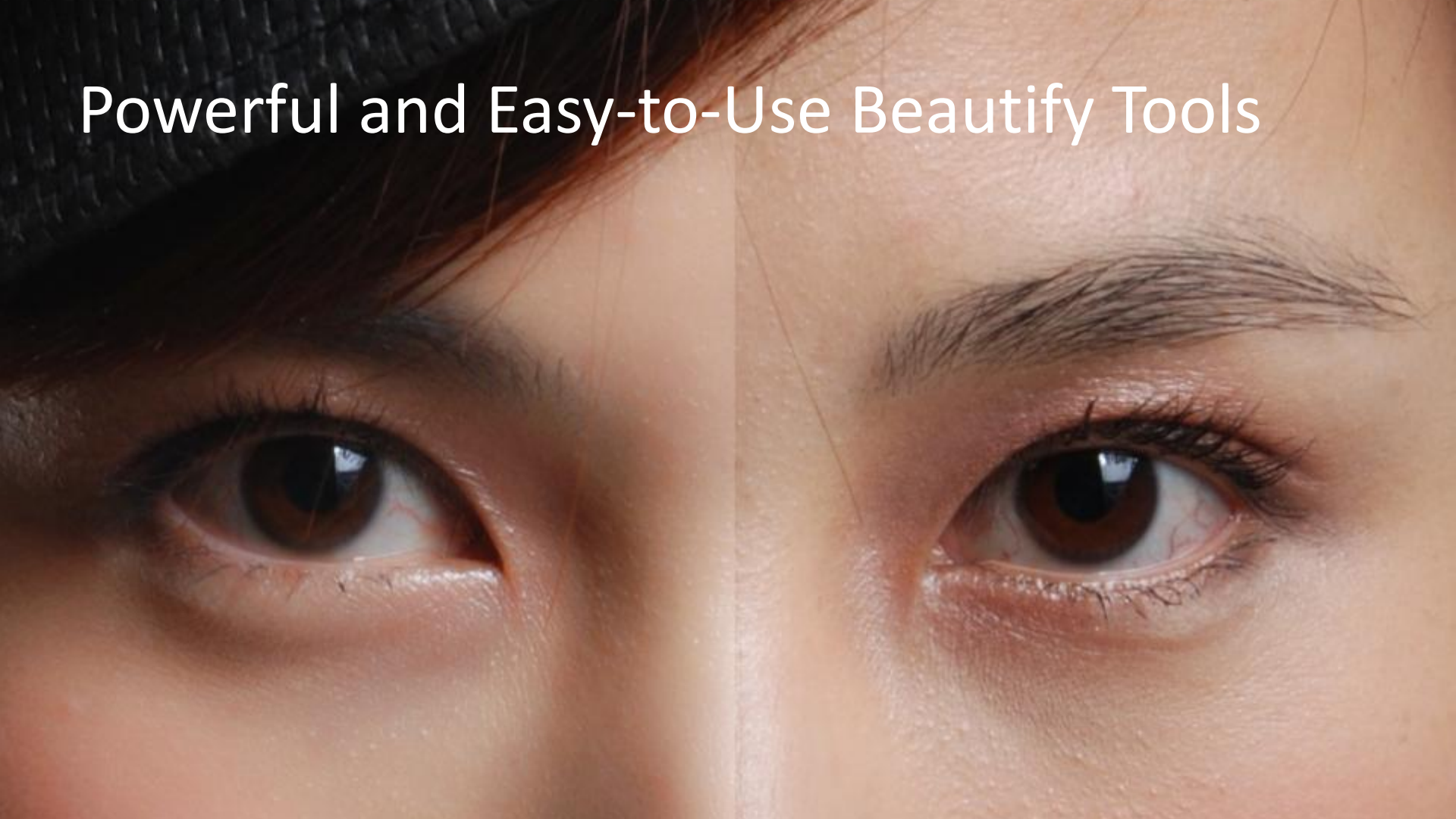


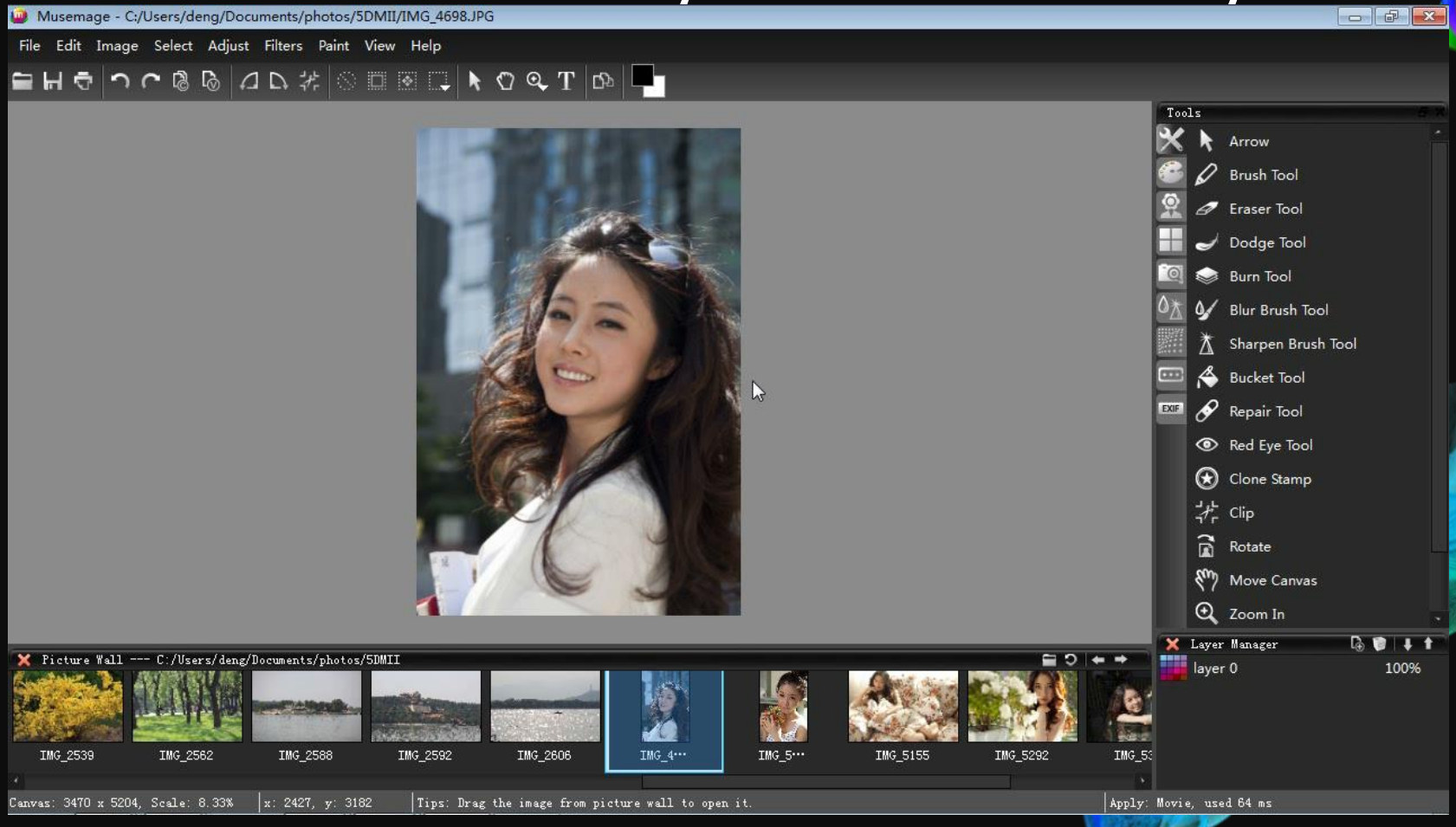
What Musemage Offers?

- Rich painting tools
- Complete color adjustment tools
- Various filters
  - Color, blur/sharpen, noising, distortions, stylize…
- Beautify tools
- Lens corrections and lens effects



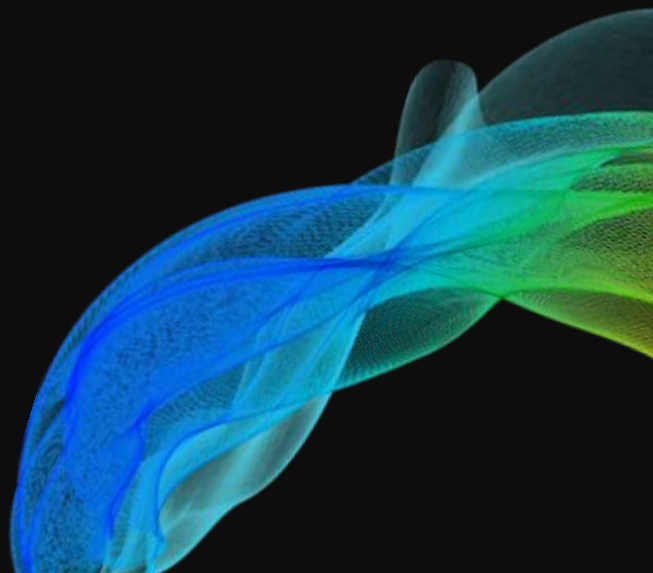

Powerful and Easy-to-Use Beautify Tools

Powerful and Easy-to-Use Beautify Tools

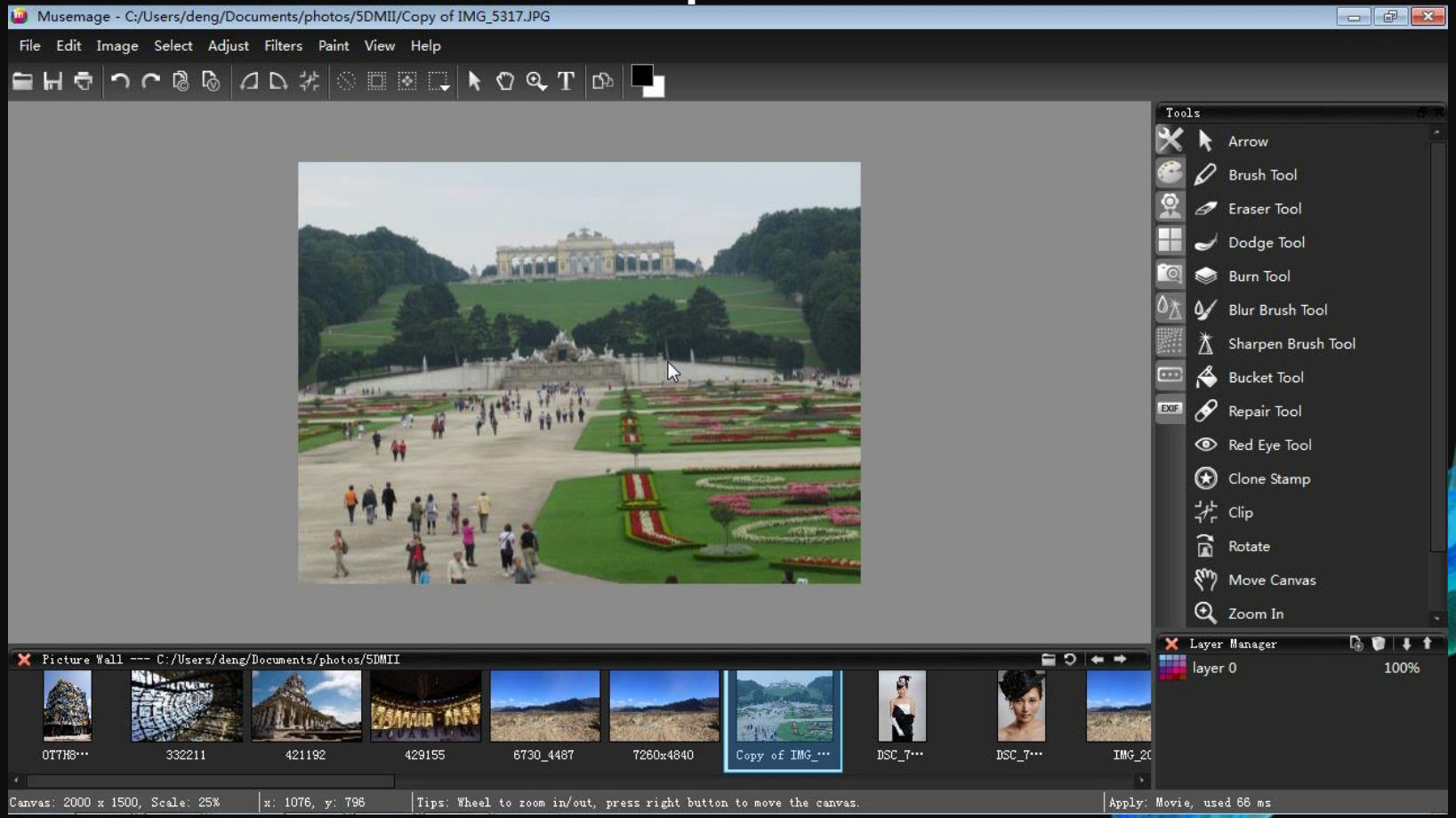


Real Time User Experience

- Real time feedback when dragging slider
- Zooming and moving picture are also available while editing
- What You See Is What You Get



Real Time User Experience



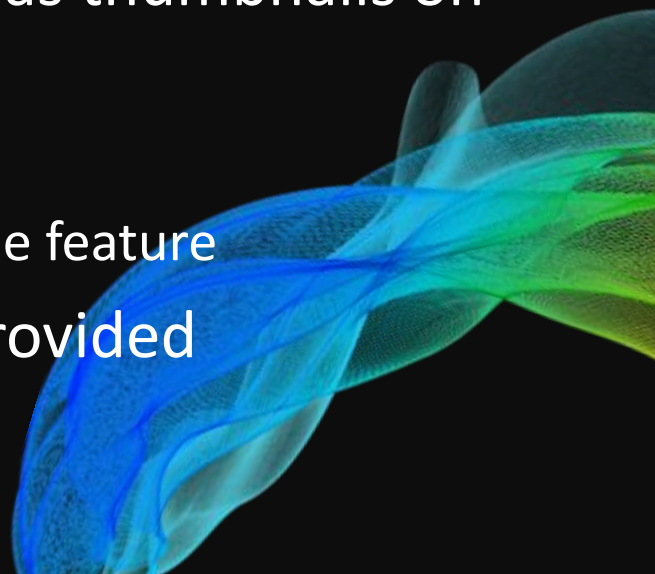
Lens Corrections and Lens Effects

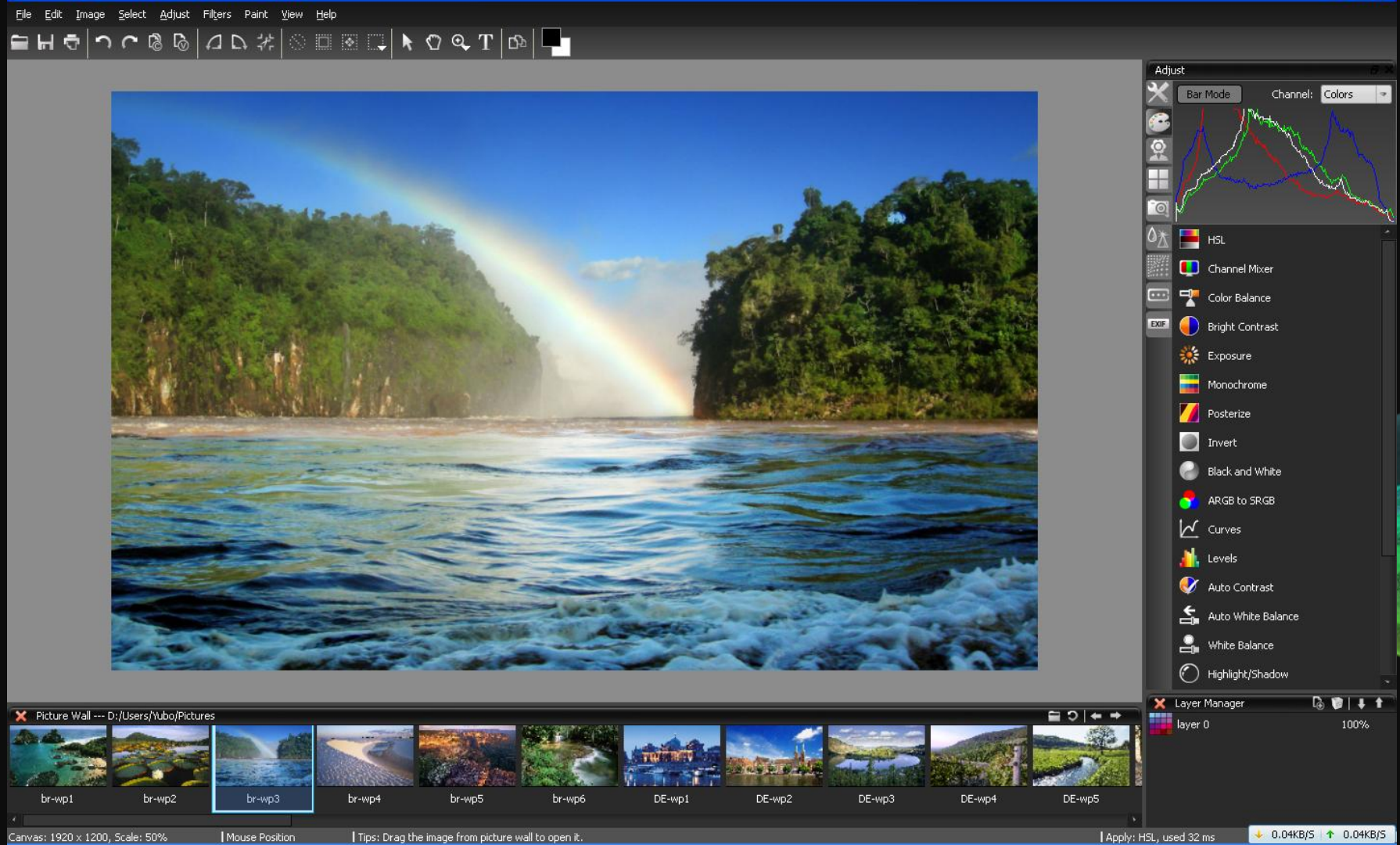
Lens Corrections and Lens Effects

Fast GPU Extraction

Simple User Interface

- All filters and tools can be easily found in the side panel
  - Filters listed as thumbnail pictures to provide effect estimation
- All pictures of current folder are listed as thumbnails on Picture Wall
  - Fast access a collection of pictures
  - More picture management functions in the feature
- Menu and hot-key accesses are also provided




File Edit Image Select Adjust Filters Paint View Help
Adjust
Bar Mode
Channel: Colors
HSL
Channel Mixer
Color Balance
Bright Contrast
Exposure
Monochrome
Posterize
Invert
Black and White
ARGB to SRGB
Curves
Levels
Auto Contrast
Auto White Balance
White Balance
Highlight/Shadow
Picture Wall --- D:/Users/Yubo/Pictures
br-wp1
br-wp2
br-wp3
br-wp4
br-wp5
br-wp6
DE-wp1
DE-wp2
DE-wp3
DE-wp4
DE-wp5
Layer Manager
layer 0
100%
Canvas: 1920 x 1200, Scale: 50%
Mouse Position
Tips: Drag the image from picture wall to open it.
Apply: HSL, used 32 ms
0.04KB/S
0.04KB/S

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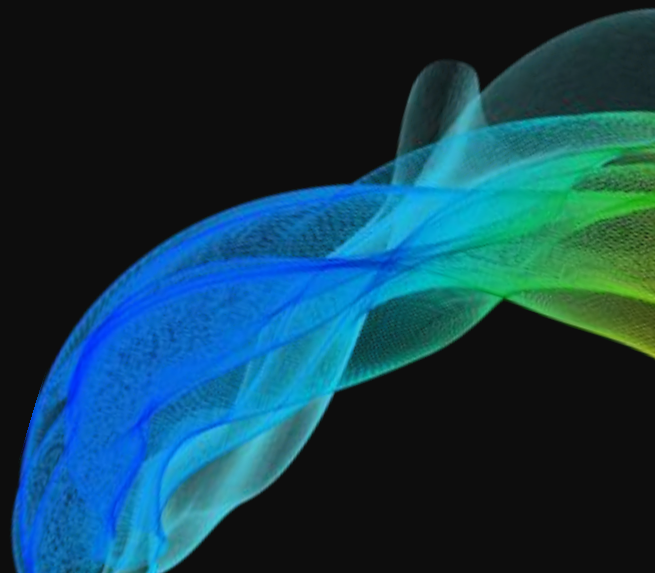
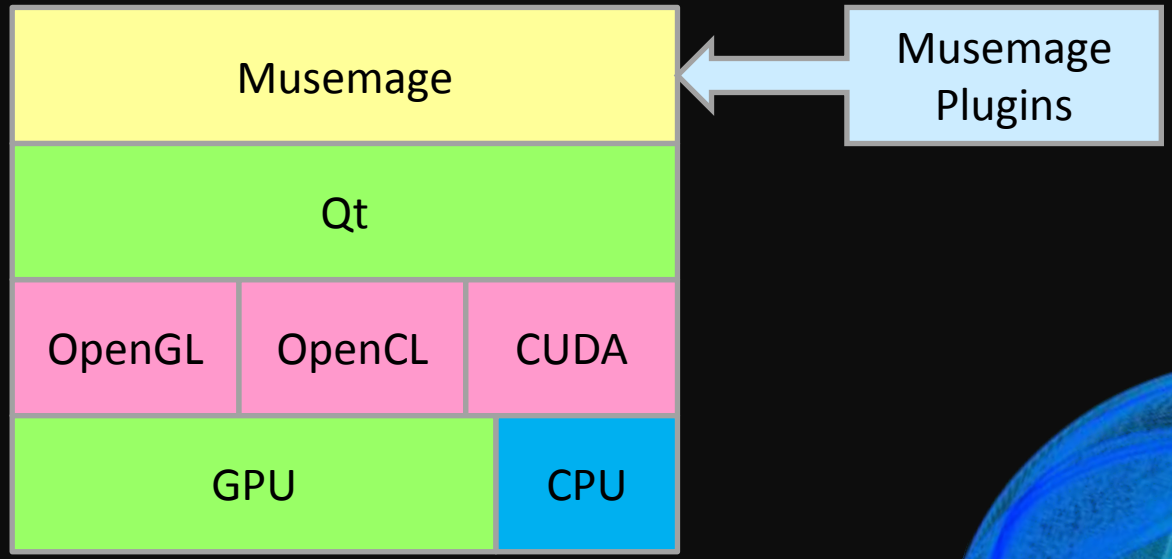
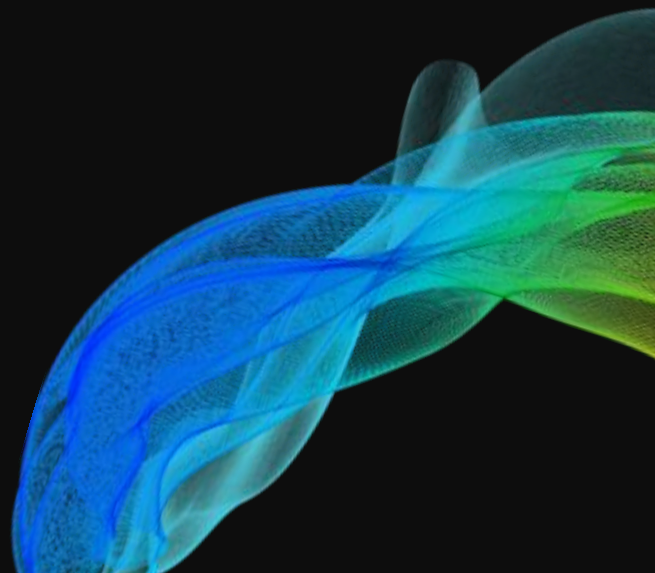
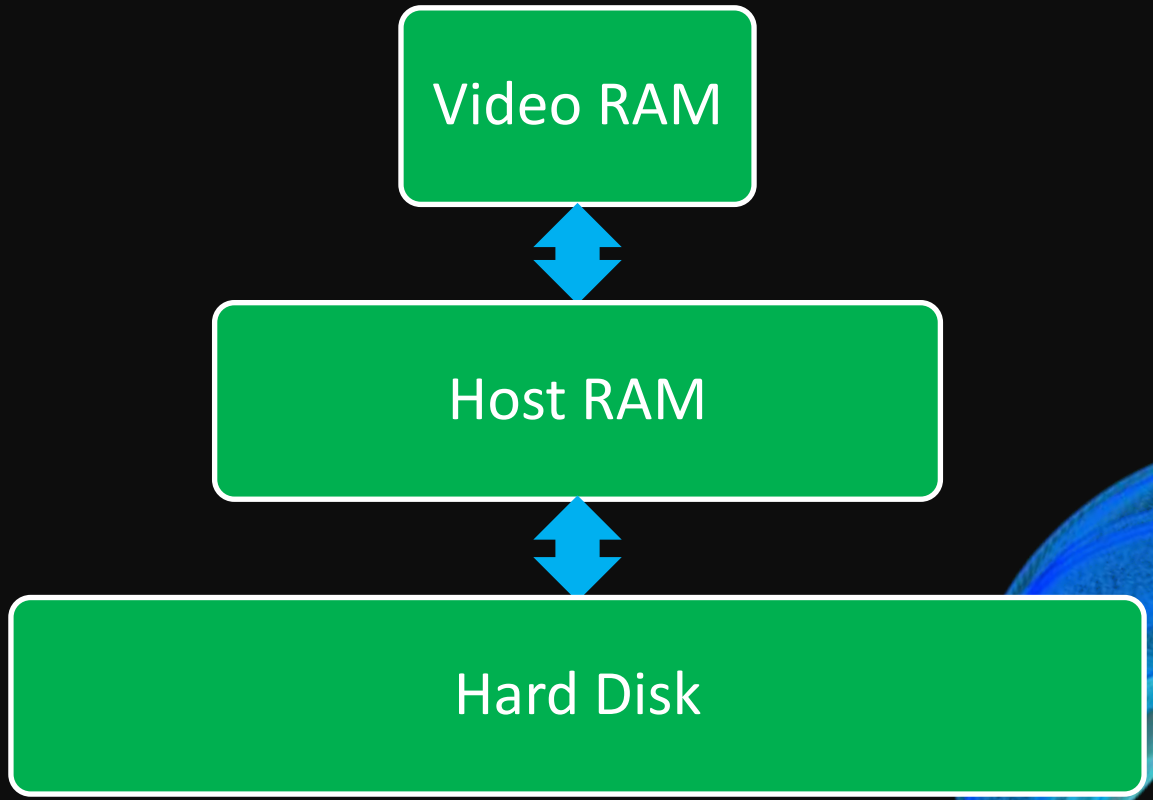


Musemage Framework

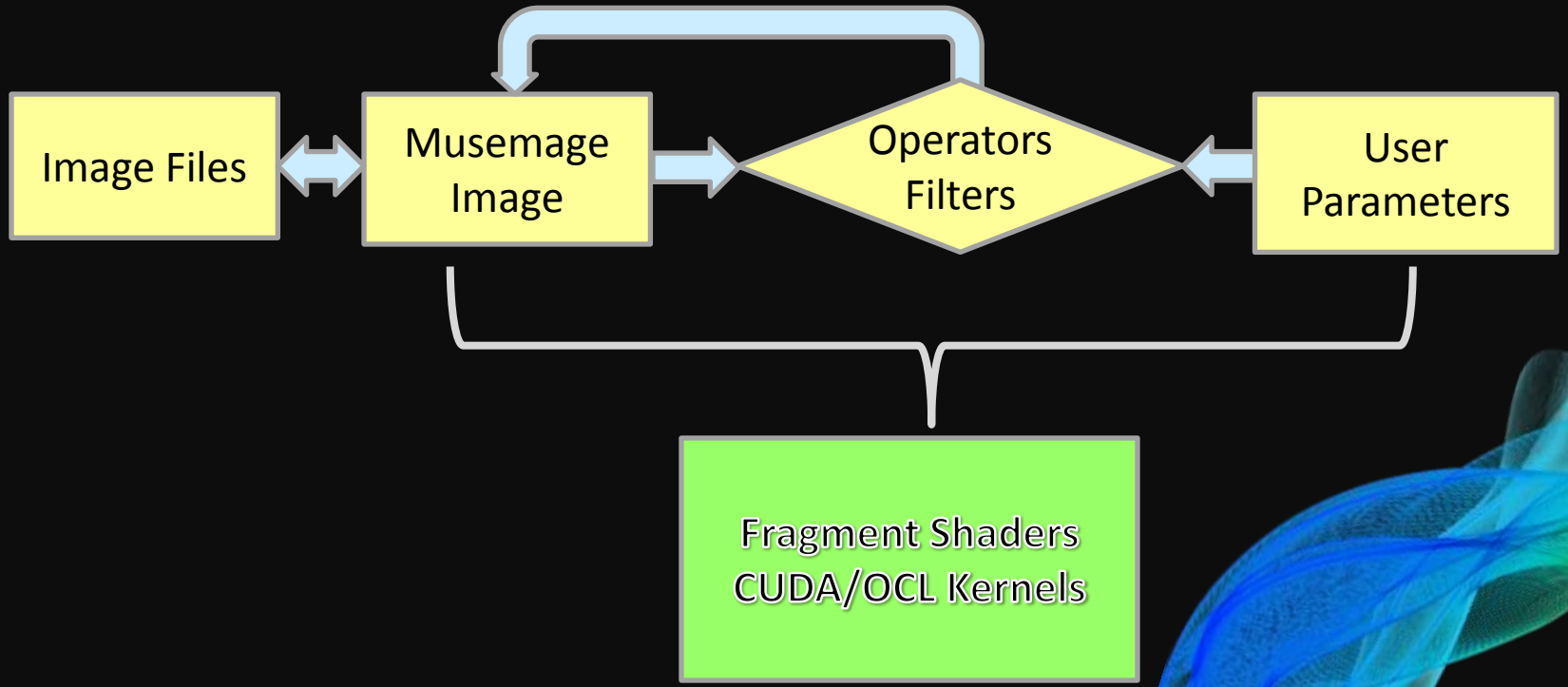




Musemage Data Management

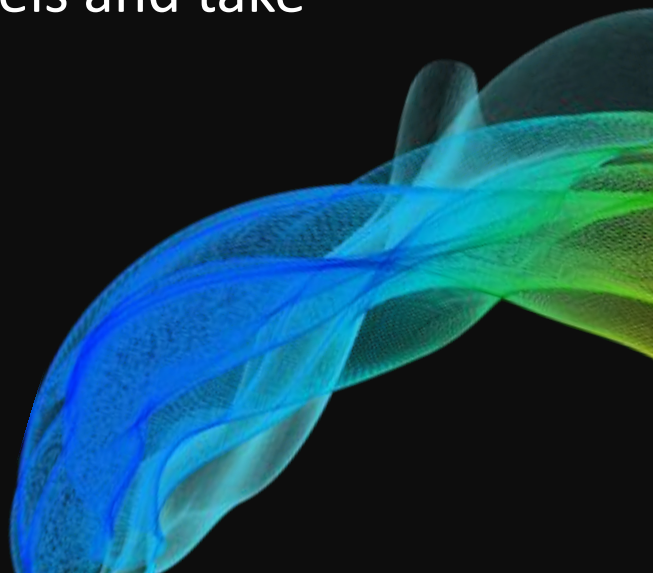


Musemage Work Flow

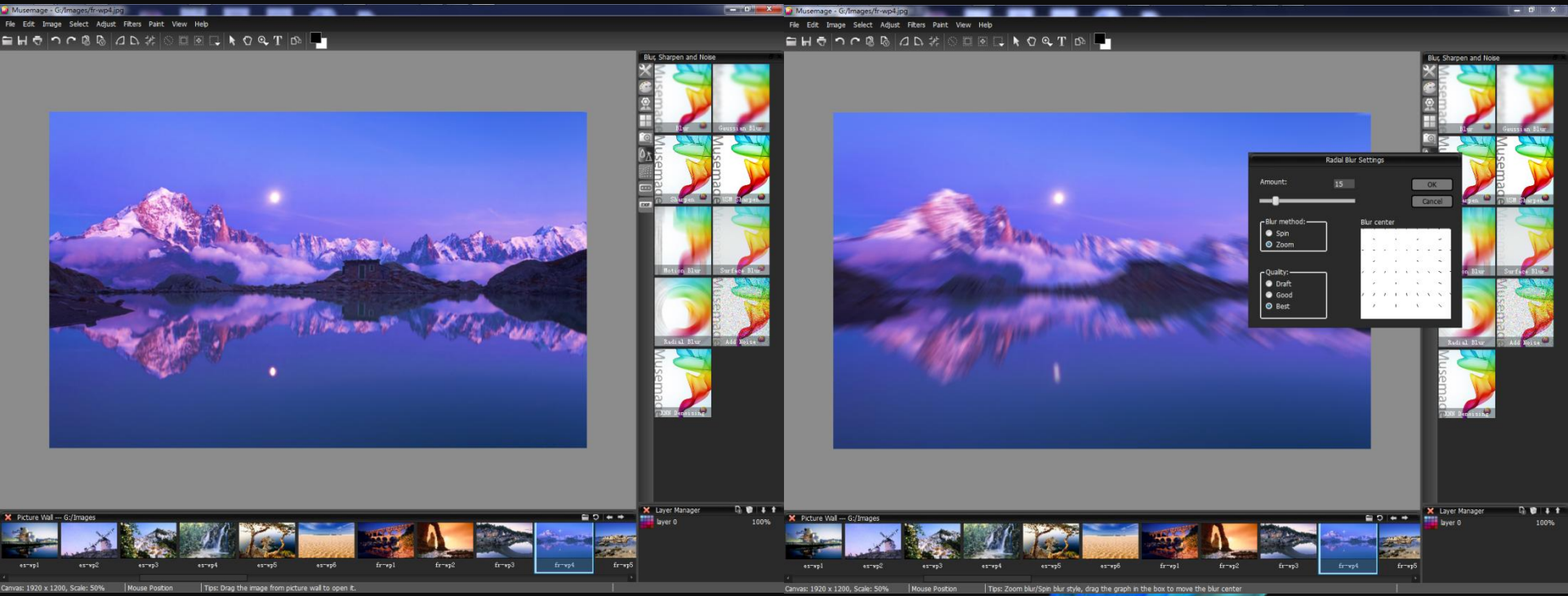


Example - Radial/Surface Blur

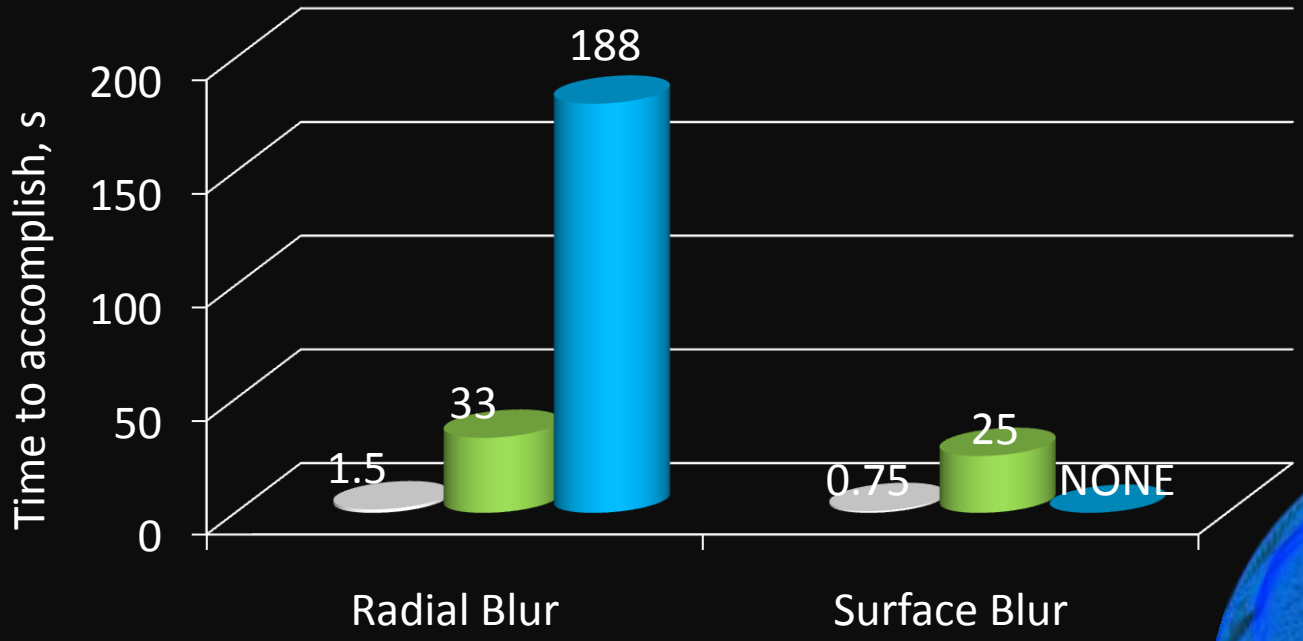
- Use GLSL fragment shaders for color sampling
  - Input color texture and selection mask texture
  - For each pixel, sample surrounding pixels and take weighted average
  - Multi-level acceleration



Radial Blur


Musemage - G:/Images/fr-wp4.jpg
File Edit Image Select Adjust Filters Paint View Help
Blur, Sharpen and Noise
Radial Blur Settings
Amount:
15
OK
Cancel
Blur method:
Spin
Zoom
Blur center
Quality:
Draft
Good
Best
Picture Wall — G:/Images
Layer Manager
layer 0
100%
Canvas: 1920 x 1200, Scale: 50%
Mouse Position
Tips: Drag the image from picture wall to open it.
Tips: Zoom blur/Spin blur style, drag the graph in the box to move the blur center

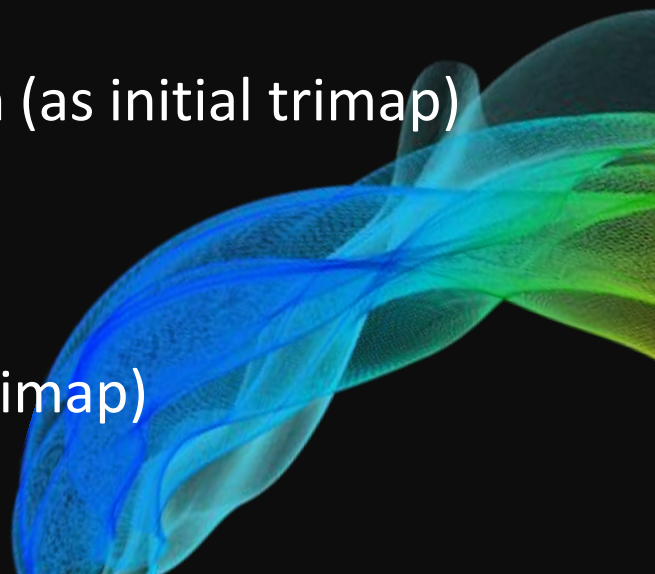
Performance Test



Platform: Intel Core i7 870, 2.93GHz
NVIDIA GeForce GTX480
21Mp 5dmark2 picture

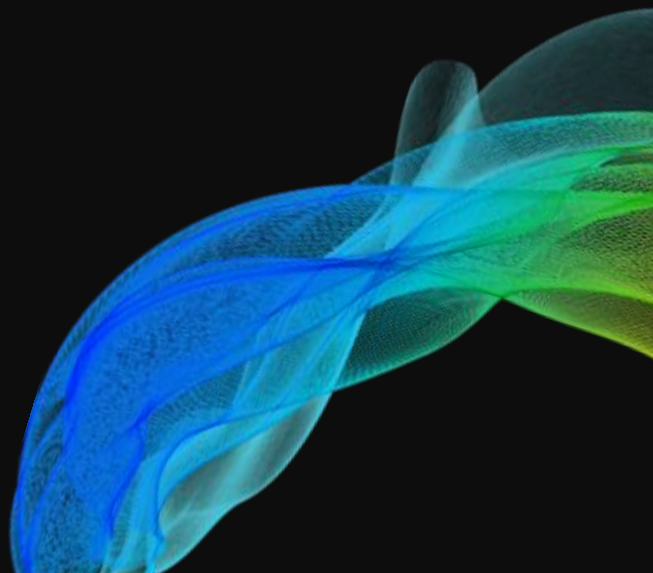
Example - Extraction Tool

- Provide binary segmentation and alpha matting
- Binary segmentation with edge optimization
  - For nearly opaque object selection
  - For semi-transparent object extraction (as initial trimap)
- Alpha matting (linear model)
  - Segmentation based
  - Direct matting (require user painted trimap)

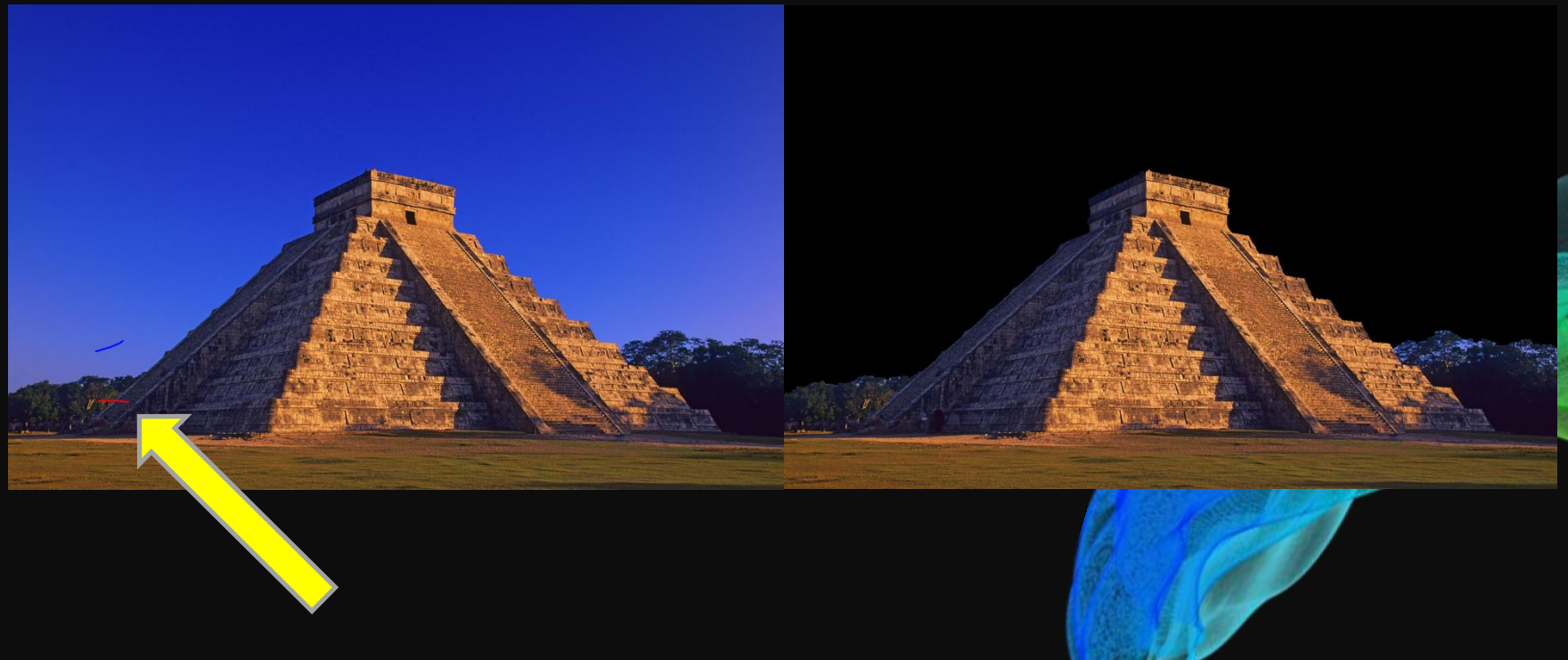


GPU Matting

- Reformulated alpha matting algorithms
  - Color sampling
  - Linear alpha blending model
- Multiple GLSL fragment shaders
  - Interactive user input
  - Trimap generation
  - Alpha estimation
  - Iterative optimization



Binary Segmentation



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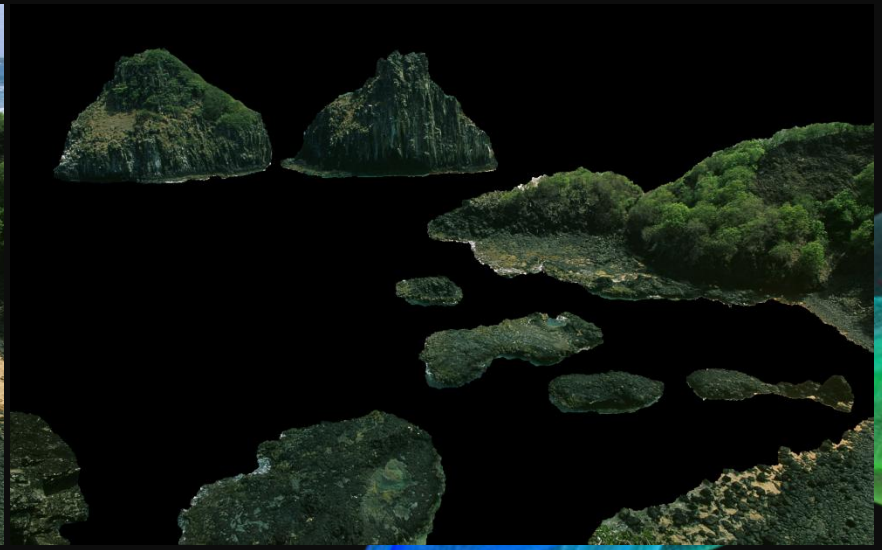
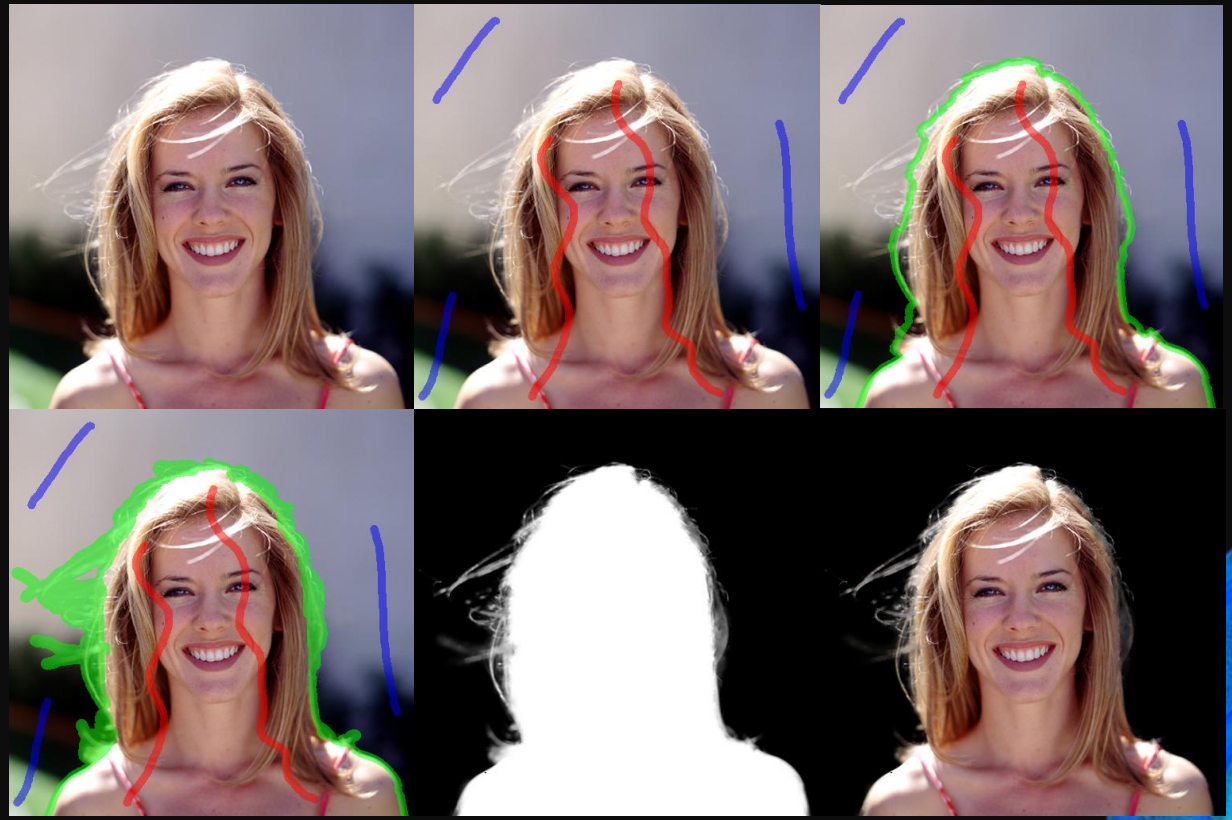


Iterative Edge Optimization

Segmentation-based Alpha Matting



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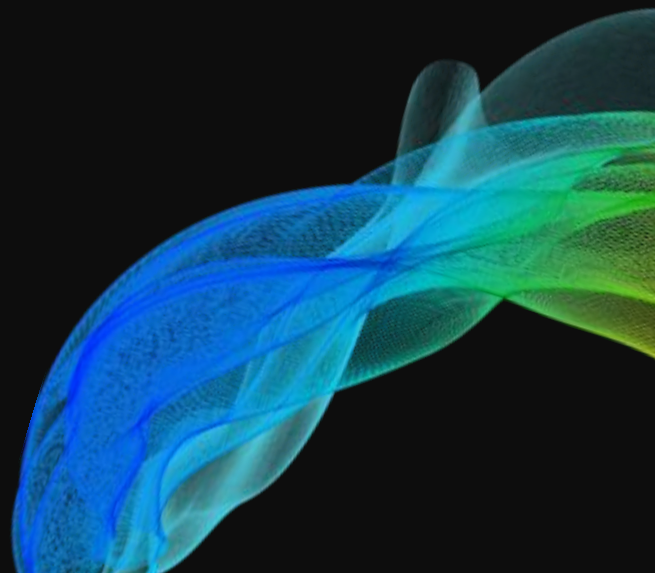
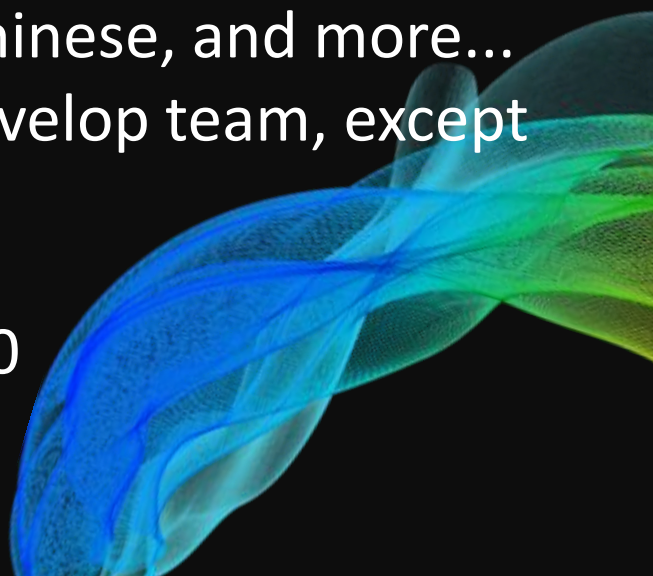


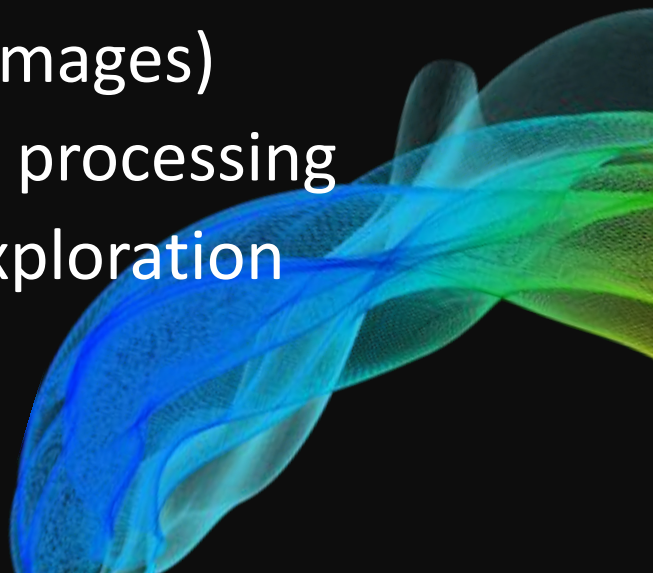
Background of Musemage

- The project started on Oct. 2009
- Standard GLSL 1.2 program
- Cross-platform — Qt, OpenGL (Windows, Linux, Mac OS)
- Multi-language interface — English, Chinese, and more...
- All codes are written by Musemage develop team, except RAW data decoding (DCRAW is used)
- Scalable software architecture
- Sep.1st 2010 to release Musemage v1.0



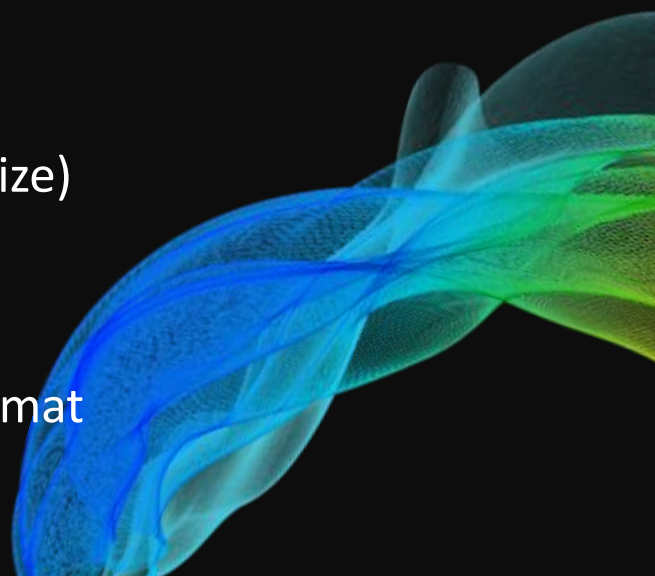
Future Works

- Improve selection and layer management
- Add channel and mask support
- More automatic functions (alpha matting, HDR…)
- Support very large images (>64MP images)
- Higher precision image formats and processing
- Improve image management and exploration
- New RAW engine
- Mac OS Version



Roadmap

- V1.5
  - GPU alpha matting and other advanced features
  - Quality enhancement and performance optimization
  - More languages
- V2.0
  - Big images (not limited by maximum texture size)
  - Enhanced layer operations and selection tools
  - CUDA/OpenCL support
  - GPU-based RAW engine and 16bit channel format



Questions?