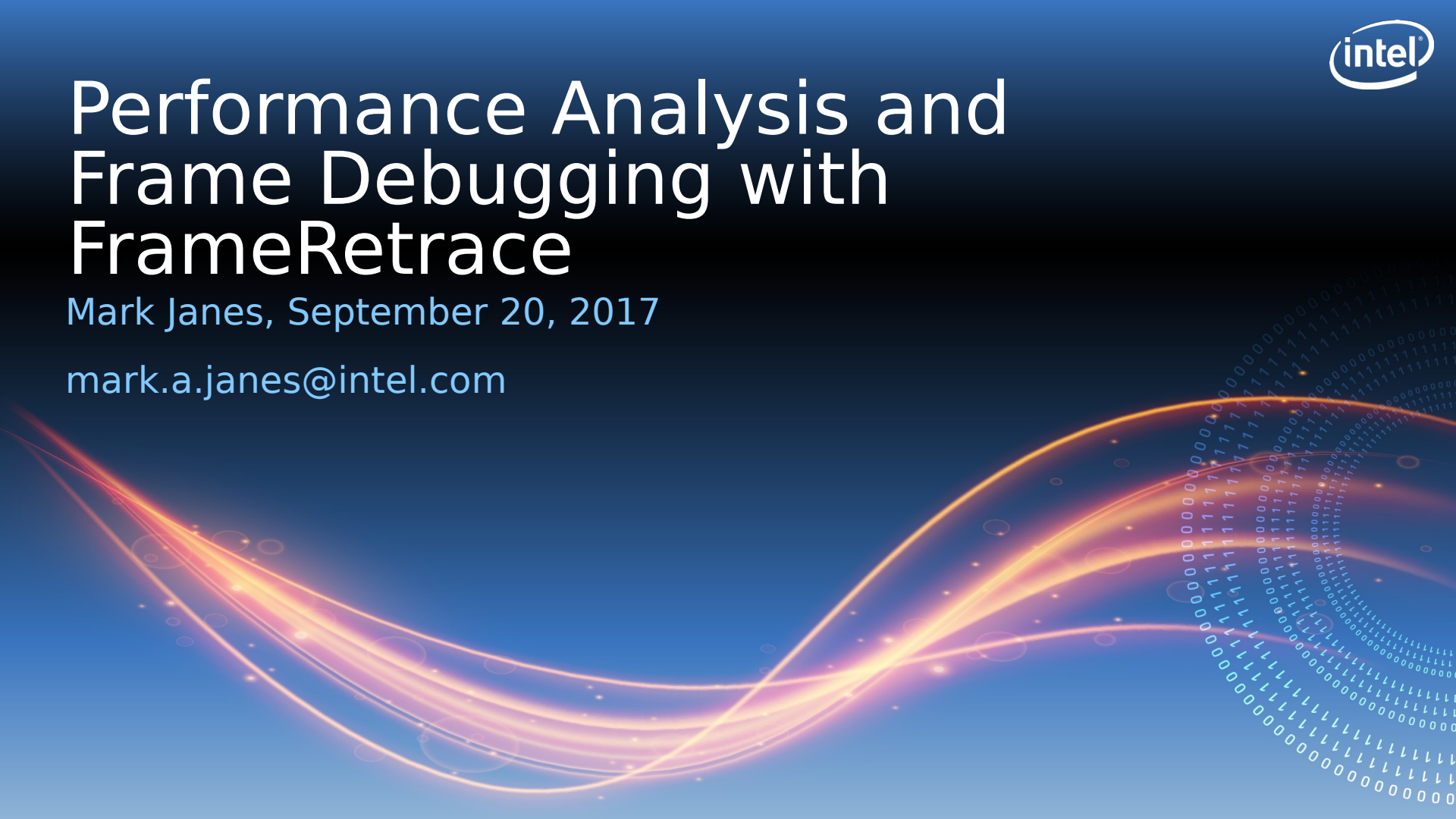

Performance Analysis and Frame Debugging with FrameRetrace

Mark Janes, September 20, 2017

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About me:

- Working on Linux platforms since 2004, with a background on embedded devices.
- Contributed to Intel’s Graphics Performance Analyzers tools for Android OpenGLES applications 2011-2014.
- Joined Mesa in 2014, working on performance tools and automation.

GPU Performance Analysis Workflow

- Investigate system bottlenecks first
  - top, gputop, rapl
  - 100% GPU utilization with lower CPU utilization indicates a GPU-bound workload
  - TDP limited workloads cause GPU clock rate to fall.
  - MESA_DEBUG=perf

GPU Performance Analysis Workflow

- CPU Bound workloads have traditional tools
  - perf, callgrind, cachegrind, sysprof
- GPU performance analysis has a sparse landscape of Linux tools
  - AMD GPU PerfStudio, Nvidia Linux Graphics Debugger, QApiTrace
  - Leverage GPU hardware counters to quantify the cost of asynchronous GPU operations.
  - Live experimentation to see the effect on performance.
  - Deeply investigate a graphics workload.

GPU Tools stumbling blocks

- Generally hardware-specific
- Mostly closed source
- Linux support is an afterthought
- Tracing/retracing not reliable
- Low numbers of users
- Mesa support for GPU performance counters

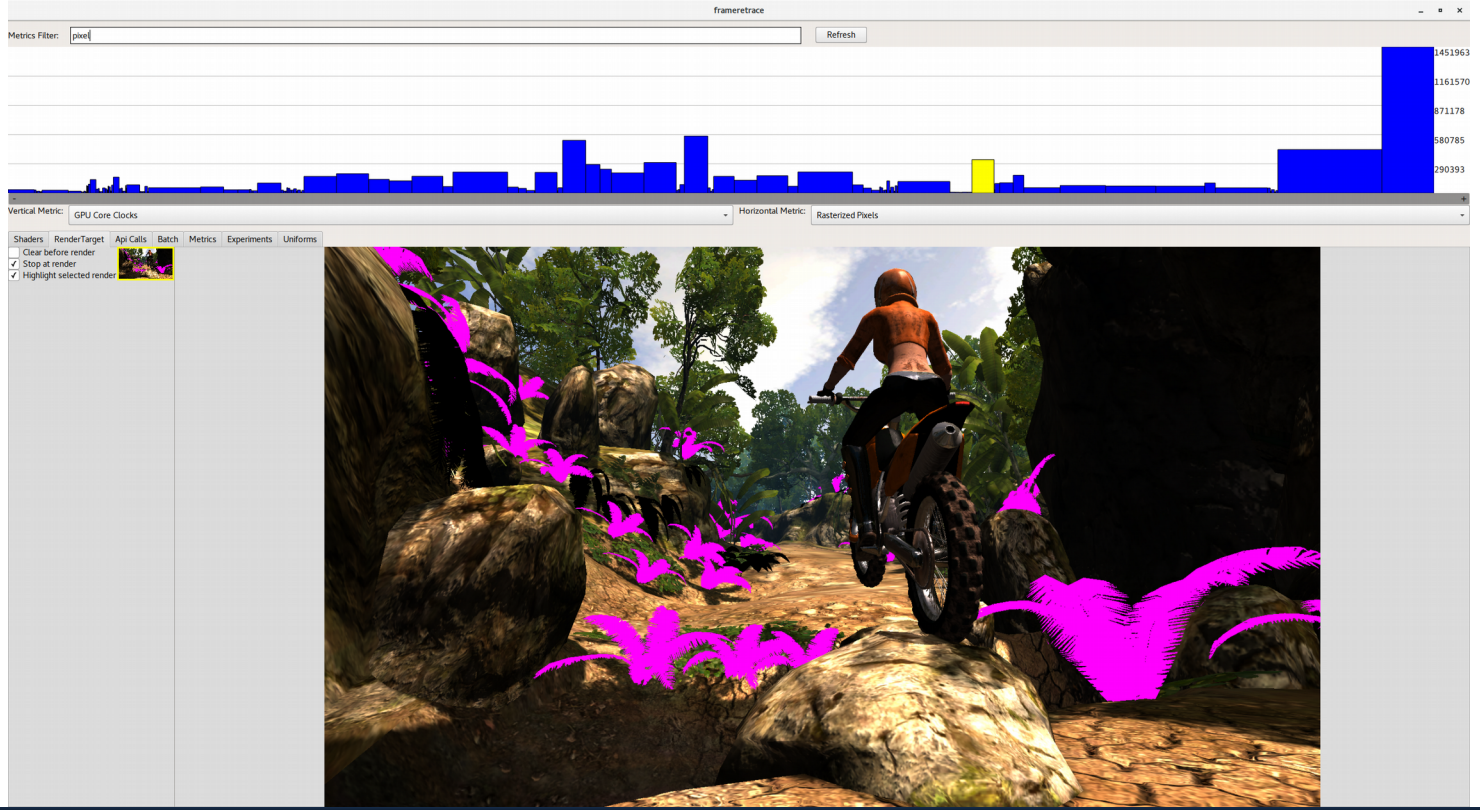
FrameRetrace: frame analysis based on ApiTrace

- Widely used and high quality trace/retrace
- https://github.com/janesma/apitrace
- Cross-platform: Linux and Windows
- Upstream GPU Counter support in Mesa and Kernel for Haswell and later.
- Leveraged by Intel Mesa team to identify and fix several performance issues in i965.

FrameRetrace: frame analysis based on ApiTrace

- GPU Metrics for each render
- Render target visualization and experiments
- Api log
- Batch disassembly
- Shader analysis, live editing, and assembly
- Uniform constant display and live editing
- Render experiments

Demo


frameretrace
Metrics Filter:
pixel
Refresh
1451963
1161570
871178
580785
290393
Vertical Metric:
GPU Core Clocks
Horizontal Metric:
Rasterized Pixels
Shaders
RenderTarget
Api Calls
Batch
Metrics
Experiments
Uniforms
Clear before render
Stop at render
Highlight selected render

Other features

- Windows support provides important leverage for open source driver teams seeking to find Mesa performance gaps.
- Proposed features:
  - Display and modify GL State
  - Display texture state, with mip clamp experiment
  - Display geometry mesh
  - Depth buffer visualization
  - Overdraw / hotspot rendertarget visualization
  - UI improvements
  - Support for more hardware

Caveats

- Currently a one-person side project, with help
  - Thanks to Laura Ekstrand, Robert Bragg, Lionel Landerwelin, Eero Taminen, Pekka Jylhä-Ollila
- Experiments require intricate state tracking
- Some workloads do not have single-frame run loops


Questions?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