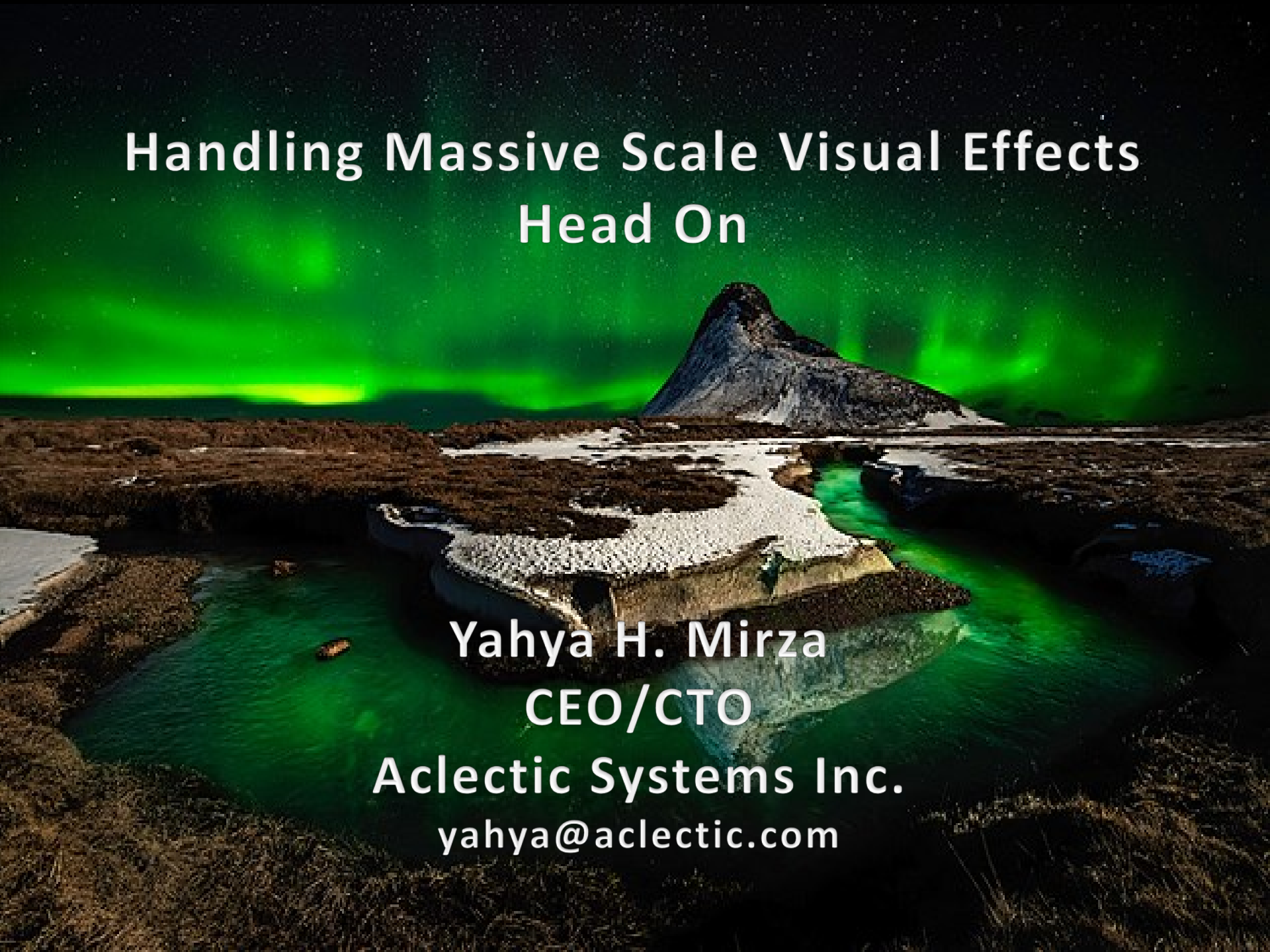
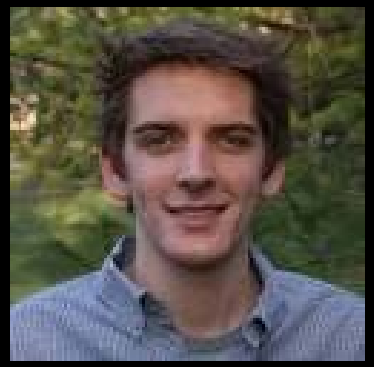
Handling Massive Scale Visual Effects Head On

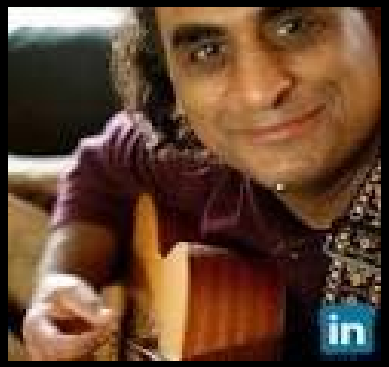


Yahya H. Mirza
CEO/CTO
Aclectic Systems Inc.
yahya@aclectic.com

Aclectic Team



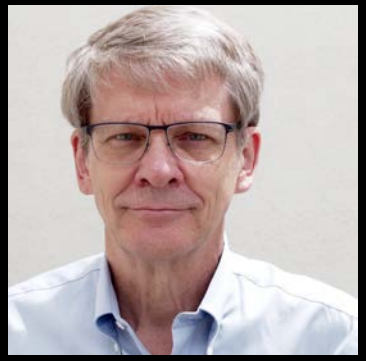
Jason Lefley
Software Engineer



Yahya H. Mirza
Founder, CEO/CTO

Dr. Todd Anderson
Modeling & Simulation

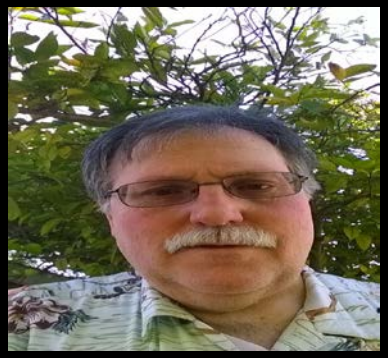
Allen Baum (Adviser)
Processor Architect



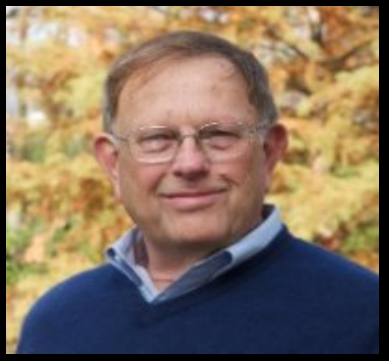
James Beck (Consultant)
Board Architect

Aclectic Advisers

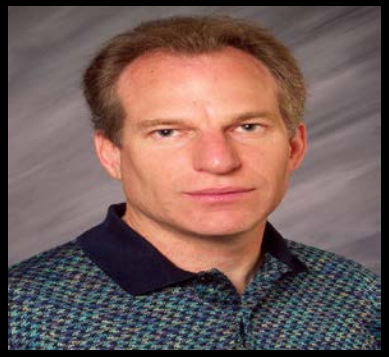
Andy Hendrickson
CTO (former)
Disney Animation



George Bosworth
Microsoft .NET
Architect
(Retired)



Dr. John McAlister
Former CEO, Chairmen
Tripos International



James A. Kahle
IBM, Fellow

Inspiration

"You've got to start with the customer experience and work backwards to the technology. You can't start with the technology and try to figure out where you are going to try and sell it."

Steve Jobs
1997 Apple World Wide Developer Conference (WDC) Keynote

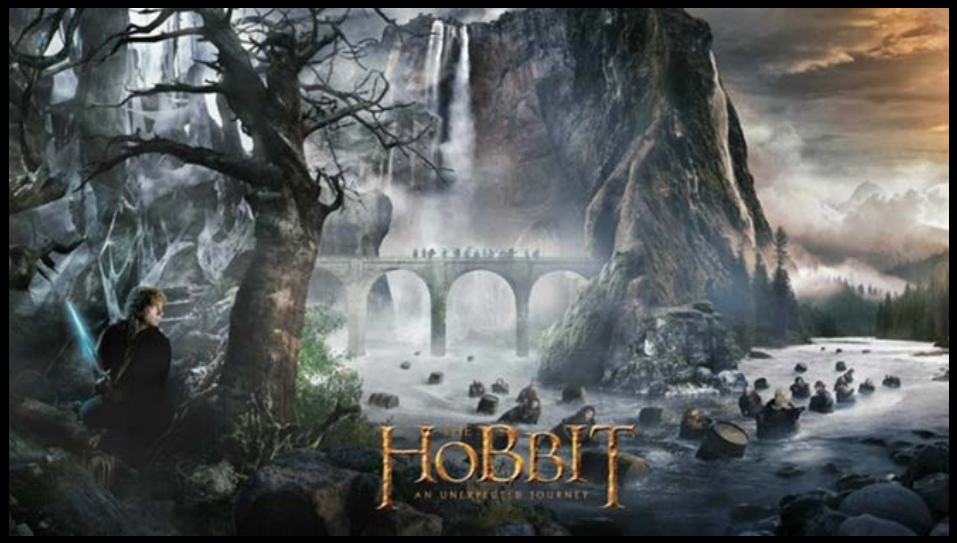
Motivation: Weta's "The Hobbit" Waterfall Barrel Sequence

"You have an idea physically of what is supposed to happen but still to simulate all that requires all new software, all new computer power, because you're taking things that take months and months to turn around."

Joe Letteri

Senior Visual Effects Supervisor

Weta Digital



"That's about a 2 KM stretch of landscape that we travel through, not to mention the millions of cubic tons of water that were pushing through the rivers of the waterfalls. So those simulations are all new, those simulations that takes days and days to run not to mention the rendering on top of it."

Joe Letteri

Senior Visual Effects Supervisor

Weta Digital

- Release: 2013
- Budget: $225,000,000
- Box Office: $860,428,000
- Crew: 1000 people.
- Frame-Rate: HFR (48 fps).
- Render-Farm: 40,000+ cores.

Motivation: Dreamworks “Puss In Boots” Tornado Sequence

- Typical Shot: 10-15 sec.
- Frame Rate: 48 Frames/sec.
- Frame Resolution: 4K
- Grid Size: 400x400x1000
- SimSteps / TimeStep: @2
- Dense: 429 GB
- @ Sparse: 143

- Grid Resolution:
  - Grid Dimensions of 400 x 400 x 1000 or about 100-200 million voxels.
  - Computed in 10-15 secs per step on a system with dual Intel Xeon X5670 processors.
  - Corresponds to more than one voxel per pixel in the final rendered images.

Exemplary VFX Production Pipeline

VFX Tool
(Houdini, Maya)

Voxelized
Geometry

OpenVDB

Scene
Description

ALEMBIC

Simulation Engine

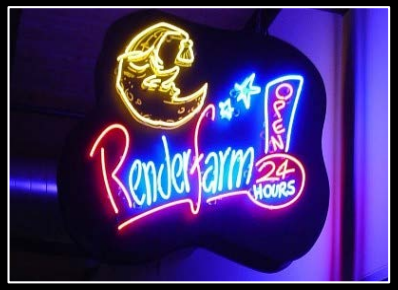
PhysBAM

Rendering Engine

Mantra Renderer

SideFX Software

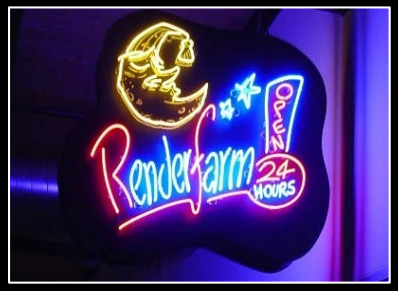
Simulation Farm



Simulation Output

OpenVDB

Render Farm



Output Format

OpenEXR

Long-Term Storage

The Challenge: How Do We Reduce a Customers CapEx and OpEx?

Efficiency is Low

- 30% utilization on a GPU for practical “REAL” production workloads.

Resolution Demands are High

- Higher resolution frame sizes demand higher resolution simulation grids
  - Rule-of-thumb for final renders is roughly 1 voxel per pixel).

Our problem is memory access latency and I/O bound, what can we do about this?

Baseline: “Smokin” FPGA Card

Emerging Technologies

Technology Options

- On-Package Memory:
  - CPU.
  - Accelerator.
- Fabric Interconnect:
  - QuickPath.
  - PCIe.
  - Nvidia NVLink / Intel OmniPath.
- Storage Protocol:
  - NVMe.
  - NVMe Over Fabrics.
- Storage:
  - Compute (DDR4, HBM, HMC, Etc.).
  - Offline (NAND, Hard Disk, Tape).

Technology Implications

- Memory
  - Access Latency.
  - Bandwidth.
  - Memory Capacity.
- Scalability of Solution.
  - Shared vs. Non-Shared.
  - Coherent vs. Non-Coherent.
  - Lock vs. Lock-less Synchronization.

Explaining Ghost Regions &

Aclectic Solution

Software: Colossus™

Hardware: Polymath™

Our initial mission is to enhance artist productivity while turning dailies into hourlies.

Simulation Parameters

Aclectic Demo

- Gridsize: 256x256x256
- TimeSteps: 500
- Dense Storage: 35GB
- Sparse Storage: 7GB
  - @22% of Dense Storage
  - Sparse storage requires only 22% of space required by dense storage for this data set

Massive Production Scale

- Gridsize: 6500x6500x6500
- 1 TB simulation data / frame.

Aclectic Simulation Demo

Aclectic Solution: Demos