

Color Enhancement for Videogames

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Activision



Color Grading and LUTs

- Last two talks
 - LUTs can emulate film emulsions in games
- Lou Levinson's talk
 - DI color grading enables creative control over look
- This talk will tie both threads together
 - In-game looks can be authored with color grading-like flexibility and applied as LUTs



Color Enhancement: Film & Game Similarities

- Same primary goal; creative control over look to:
 - Manipulate the mood of the viewer
 - Call attention to important visual elements
 - Etc. (recall Lou Levinson's talk)
- Similar advantages: easy to art direct, allows for changes late in production, etc.



Color Enhancement: Film & Game Differences

- In games, can't tweak with same precision since scene content changes in unpredictable ways
- In games, desirable for dynamic game state (such as player's health) to also affect color



Traditional Game Color Enhancement

- Applied in a full-screen pass after rendering the scene geometry and effects (“post pass”)
- Using shader math driven by variables like saturate / desaturate, RGB tint, contrast
- These settings keyed to game location, game events, script triggers etc.



Game Color Enhancement with 3D LUTs

- Graphics hardware can access a small 3D texture (16^3 or 32^3) as fast or faster than the typical color enhancement shader math
- Use input RGB as coordinates, lookup new color
- Opens up many possibilities for color operations
- But how to author?



Two Techniques for Game LUT Authoring

1. Use a custom app which ties into the game engine (or actually runs in game)
2. Author 3D LUTs in an external application



Example of in-engine Authoring: Valve's Source Engine

- Valve pioneered this technique (and the use of 3D LUTs in videogames)
- Their interface includes
 - Common Photoshop operations such as curves, levels and color balance
 - Basic selective (secondary) color enhancement
 - Can apply multiple layers of operations



Lookup View



Valve Color Enhancement Interface

Images used with Valve's permission

Balance

- Cyan: -11
- Magenta: 6
- Yellow: 0
- Red: 0
- Shadows
- Midtones
- Highlights
- Preserve Luminosity
- Blend Factor: 255

Levels

Channel: RGB

Output Level

Blend Factor: 255

Curves

Channel: RGB

Blend Factor: 255

Color Correction Tools

- Enable
- Enable Entities
- Blend: 255
- Curves
- Levels
- Balance

New Delete Up Down Save

Selected HSV

Select Nearby RGB Select

Colorize Invert Selection

Hue: 0

Saturation: 0

Value: 0

Tolerance: 51

Fuzziness: 0

Blend Factor: 255

Authoring LUTs Out-of-Engine

- Take “identity LUT” (result same as input RGB)
- Slice (e.g.) 32x32x32 cube into 1024x32 strip:



- Grab (uncorrected) screenshot from the game, paste “identity LUT strip” on it
- Give screenshot + LUT strip to artist to perform color manipulations in external app
- Convert strip back to 3D LUT, import into engine

Authoring LUTs Out-of-Engine

- History of this technique in the course notes
- Not ubiquitous yet, but becoming mainstream
- Natively supported by major middleware engines
 - Unreal Engine, CryEngine
- Also implemented into homegrown engines
 - At EA, Activision Blizzard, others



Pros / Cons of In-Engine LUT Creation

- Pros:
 - Immediate feedback
 - Artist sees color exactly as it appears on target
- Cons:
 - Need to implement custom tool
 - Every new operator and interface needs to be implemented separately



Pros / Cons of External LUT Creation

- Pros:
 - Use any app, from Photoshop to pro grading tools
 - Much more power and flexibility, no need to implement custom tool
- Cons:
 - Iteration time
 - Matching color to target platform difficult, can use techniques similar to film DI to solve



Example: Left 4 Dead (Valve)

- Horror game
 - Dark, scary cinematic environment
- “Filmic” Effects used communicate player state and enhance dark setting



Example: Left 4 Dead

- Unify/simplify the palette
 - Call out specific colors that are important for navigation/gameplay
- Some game entities, particularly the protagonists, are designed with this color correction operator in mind and retain their saturation relative to the more desaturated environment



Example: Left 4 Dead (No Effects)



Image used with Valve's permission



Example: Left 4 Dead (Color LUT)



Image used with Valve's permission



Example: Left 4 Dead (All Effects)



Image used with Valve's permission



Example: DJ Hero 2 (Freestyle)

- Music rhythm game
- Dance clubs, complex lightshows and pyrotechnics
 - The color enhancement adds additional stylized, over-the-top effects synchronized to the music
- Use Photoshop (including color grading plugins)



Example: DJ Hero 2



no LUT

Image used with Activision's permission

DJ
Hero 2

Example: DJ Hero 2



green scale

Image used with Activision's permission

DJ
Hero 2

Example: DJ Hero 2



sepia

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DJ
Hero 2

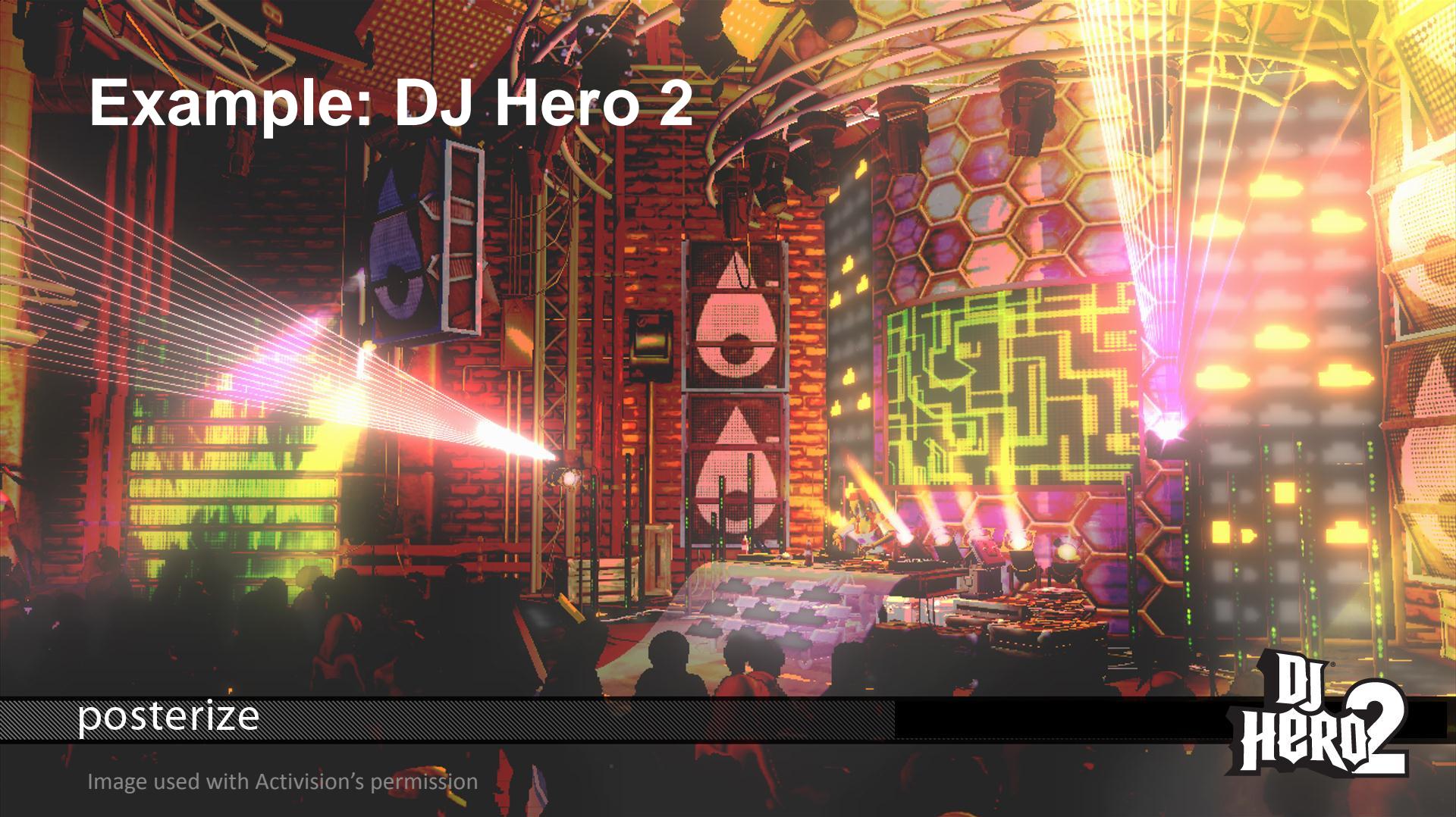
Example: DJ Hero 2

only green

Image used with Activision's permission

DJ
Hero 2

Example: DJ Hero 2



posterize

Image used with Activision's permission

DJ
Hero[®]
2

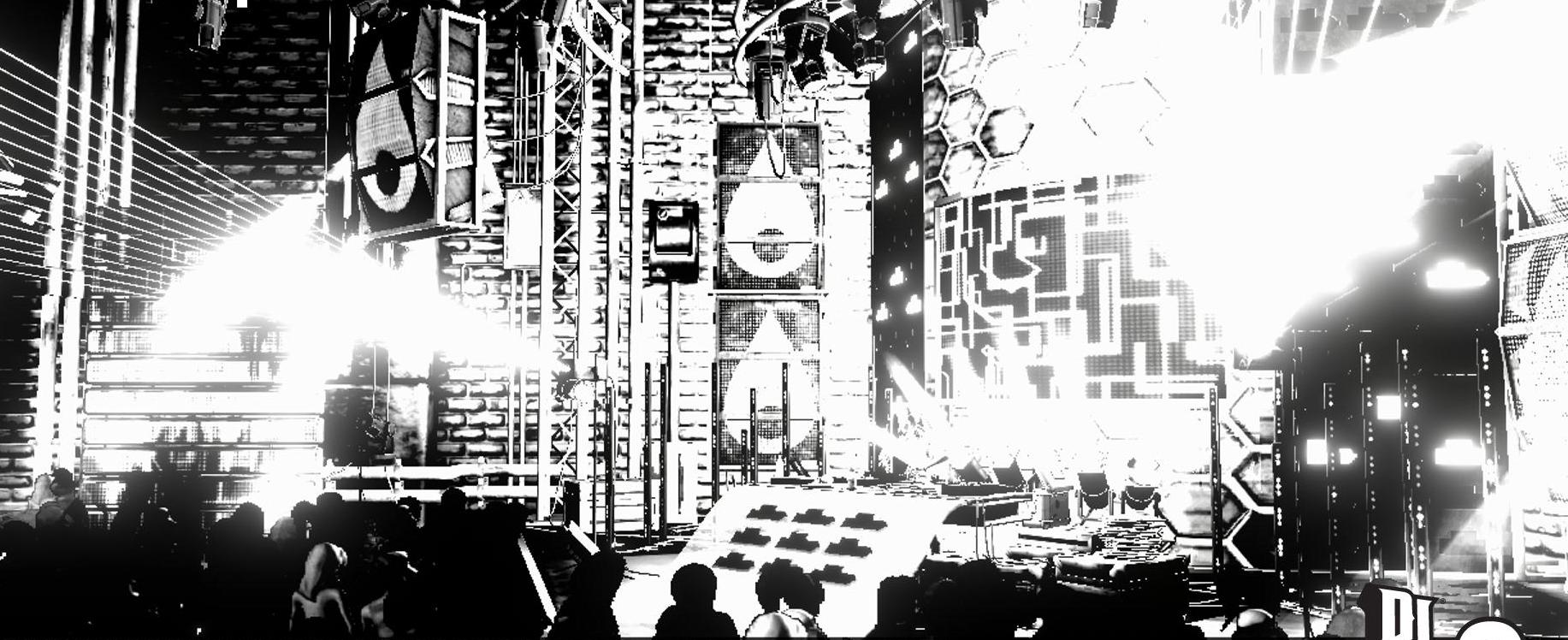
Example: DJ Hero 2

threshold 75

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DJ
Hero 2

Example: DJ Hero



threshold 25

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DJ
Hero 2

Example: DJ Hero 2



invert RGB

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DJ
Hero²

Example: DJ Hero 2



lightness invert

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DJ
Hero 2

Example: Guitar Hero 5 (Neversoft)

- Similar game genre to DJ Hero
- But goals of color enhancement are different
 - Help establish mood the mood of the scene
 - Reinforce a particular style for each venue
 - Less extreme color transformations



Example: Guitar Hero 5

- Use Sony Vegas
 - Load a variety of screenshots and scrub back and forth to make sure LUT works in different situations
 - Use a variety of color operations
 - Curves, levels, hue adjustments, brightness / contrast, color balance, three-way color correction (primary & secondary), gradient map, HSL adjustments, invert, etc.





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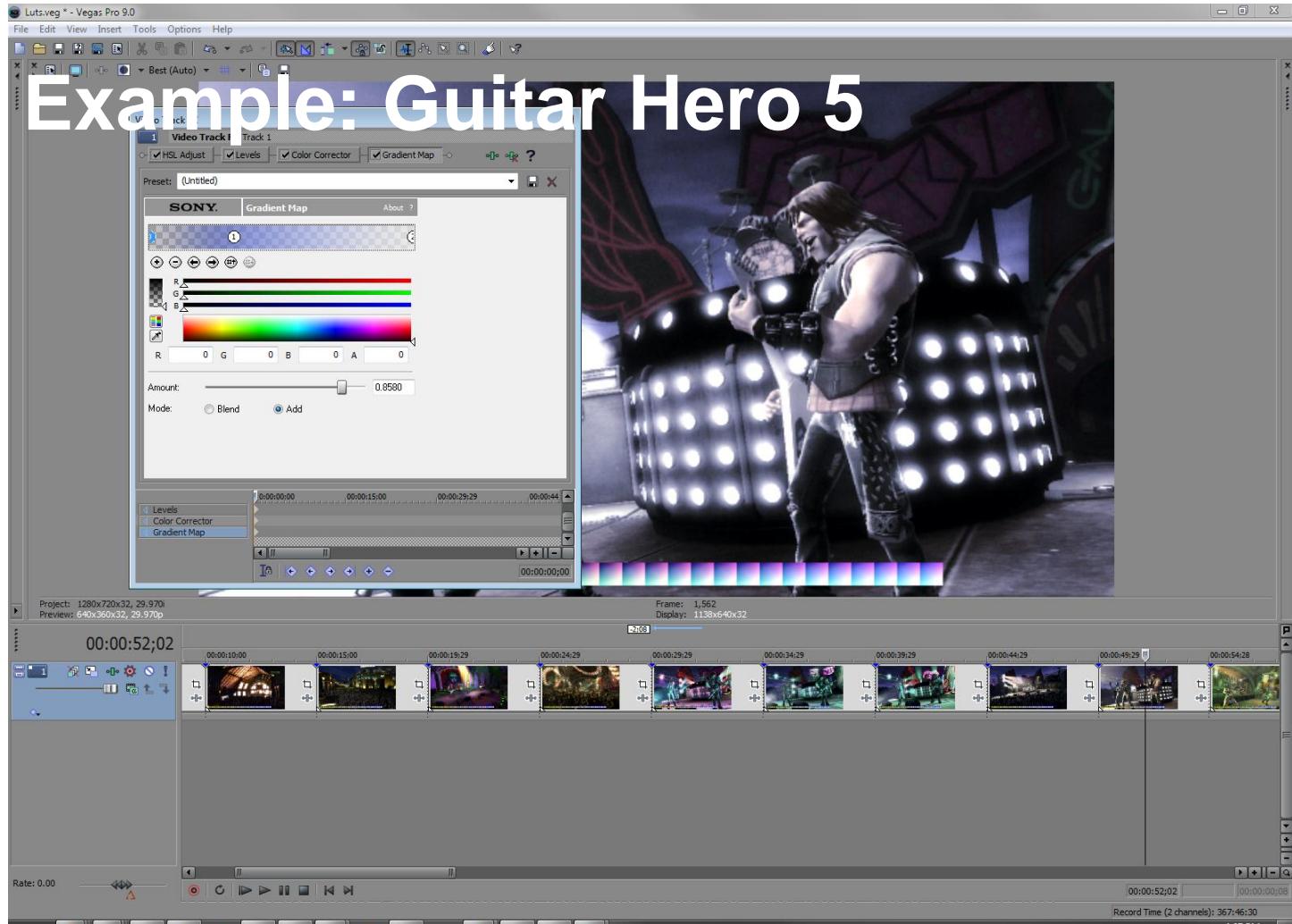


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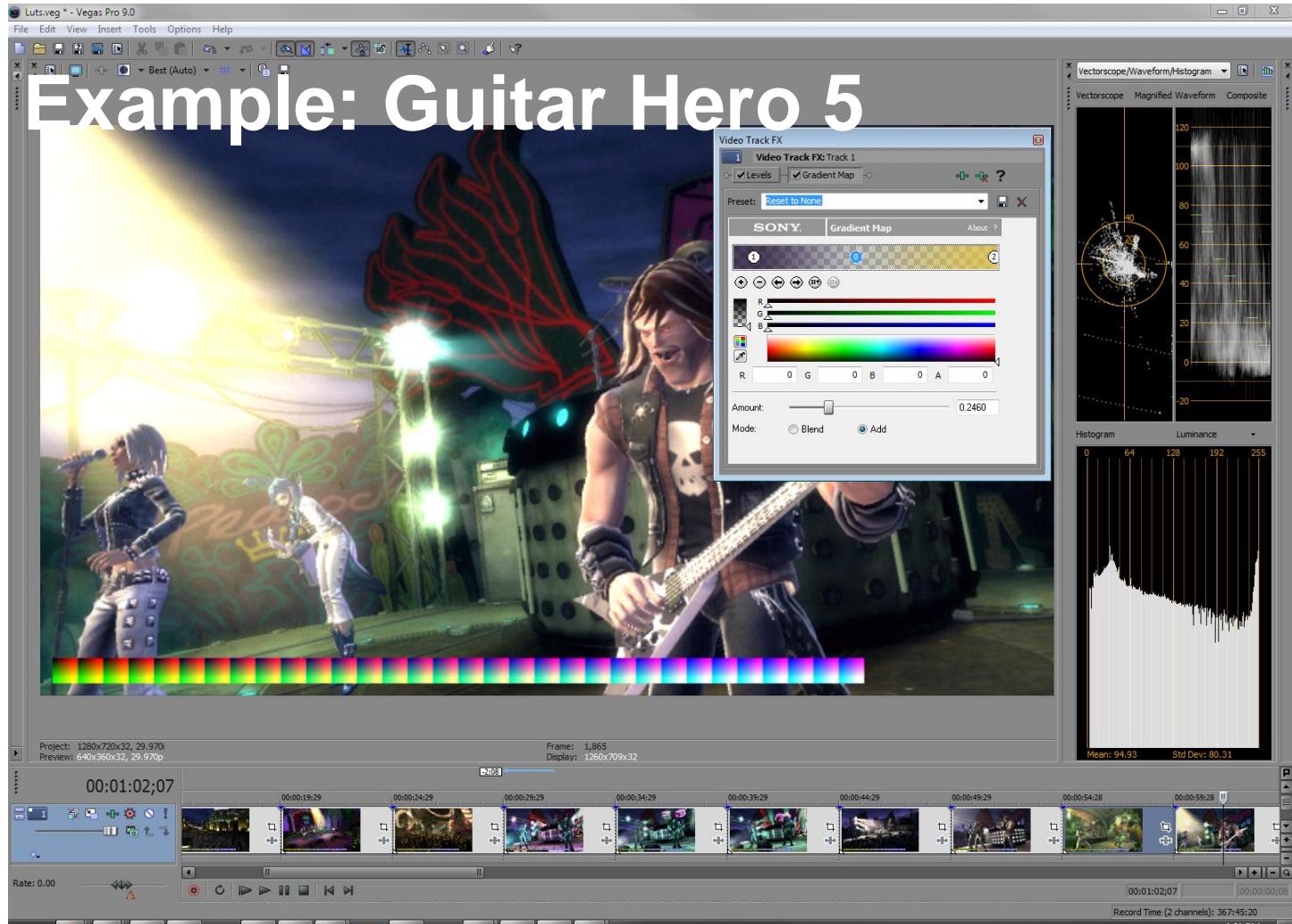


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Luts.veg * - Vegas Pro 9.0

File Edit View Insert Tools Options Help

Best (Auto)

Example: Guitar Hero 5

Project: 1280x720x32, 29.970
Preview: 540x360x32, 29.970p

Frame: 1,865
Display: 1260x709x32

00:01:02:07

Rate: 0.00

00:00:19:29 00:00:24:29 00:00:29:29 00:00:34:29 00:00:39:29 00:00:44:29 00:00:49:29 00:00:54:28 00:00:59:28

00:01:02:07 00:00:00:08

Record Time (2 channels): 367:44:50

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Calibration

- However the LUTs are authored, it's important for the artists to have properly calibrated TVs and viewing environments
- Similar to setups for mastering home video (eg Blu-ray) editions of feature films
- Need to also test on “typical consumer setup”



Acknowledgements

- Kyle McKisic for Guitar Hero 5 info and screens
- Jason Mitchell for Left 4 Dead info and screens
- Phil Bale for DJ Hero 2 info and screens
- Other course speakers for discussions and ideas

