Projection Overview

Overview

In this section, you'll learn all about projection:

- Projector Classification : what's good for what?
- Projector Lenses : defining throw ratios and the positive / negative of lens types
- Projector Manufacturers
- Projector Rigging & Hardware
- Projector Math : there are a bunch of formulas
- Projector Positioning : where does the projector go based on what I want to light up?
- Projector Drafting : how to draw a frustum
- Projector Troubleshooting : how to fix some basic run-of-the-mill problems
- Projection Mapping

Projector Technology Classifications

History & Types: Projectors have evolved from 35mm, slide, and overhead projectors to digital models used in various settings.

Digital Projector Technologies: Key types include DLP, LCD, LED, and LCoS, each with unique features and pros/cons.

Key Projector Technologies:

- DLP (Digital Light Processing)
  - Uses microscopic mirrors and a spinning color wheel.
  - Types: Single-chip, three-chip, 4K, short-throw, portable, and interactive DLP projectors.
  - Pros: High image quality, color accuracy, minimal motion blur, fast response time, durability, low maintenance.
  - Cons: Limited brightness, rainbow effect, limited color gamut, color wheel replacement, limited zoom and lens shift.
- LCD (Liquid Crystal Display)
  - Utilizes three LCD panels for color blending.
  - Types: Home theater, business, portable, short-throw, and interactive LCD projectors.

    - Pros: Bright images, good color accuracy, excellent black levels, quiet operation, high light output, minimal rainbow artifacts.
    - Cons: Potential motion blur, lower contrast ratio, limited color gamut, image distortion, limited zoom and lens shift.
- LED (Light Emitting Diode)
    - Based on either DLP or LCD technology but uses LED as a light source.
    - Types: Pico, pocket, portable, and short-throw LED projectors.
    - Pros: Long life (20,000+ hours), energy-efficient, bright colors, minimal maintenance.
    - Cons: Higher initial cost, limited zoom and lens shift, may lack 3D support.
- LCoS (Liquid Crystal on Silicon)
    - A hybrid between LCD and DLP, uses liquid crystal chips with reflective backing.
    - Types: 4K, 3D-enabled, high-end, interactive, and business LCoS projectors.
    - Pros: Superb image quality, excellent contrast, deep blacks, high resolution.
    - Cons: Heavy, higher price, potential motion blur, limited rainbow artifacts.

Projector Hardware

In general when you see a “K” after a number when talking about projections - it is referring to the brightness-Lumens in the thousands. So 5k = 5000 Lumens. This is *not* referring to color temperature or resolution. That said you might get a model name like 4k32 which means 4k resolution, 32k lumens. Confusing! (If you see 4k30 or 4k60 in a spec, this may refer to 30 or 60 fps, not lumens!, extra confusing!)

Projector Size Classifications

- Pico - mini projectors. Usually less than 500 lumens, but can be found up to 1k lumens. Fixed lens with variable focus.
- Classroom - What you might find in a classroomclass room or your apartment. Usually <5k. Fixed or zoom lens with variable focus.
- Installation - What you might find in a museum or your rich friend’s screening room. Usually <15k.. Interchangeable lenses of all kinds.
- Cinema - What you might find in a movie theater, music venue, or large scale projection mapping. Usually >15k. Interchangeable lenses of all kinds.
- Moving Head Projectors - A specialty projector that is mounted on a moving head servo, allowing for physical motion (pan, tilt, twist) of the projectors output.

Projector Throw

Projector throw is the ratio between distance of the projector to the target surface and the width of the projected image at that distance. The example I always give is with a 1920x1080 projector, your aspect ratio is 16:9. If we want to project an image that is 16’ wide by 9’ tall, and our lens has a throw ratio of .5:1, we need the projector to be 8’ away from the target surface: 16’ multiplied by

.5 is 8’!

Throw Distance = Target PRJ Width x Throw Ratio

See more throw formulas here.

Projector Lenses

There are a ton of different types of lenses. Different executions require different solutions.

Projector lenses, like camera lenses, arelenses are either interchangeable (you can change the lens on the projector body) or fixed (you can’t change the lens). Fixed can also define whether a lens has zoom capabilities or not.

In addition to their throw ratio, here are some lens property variables:

- Interchangeable or Fixed
- Zoom: Variable or Fixed
- Throw Categories: UST (Ultra-Short Throw), ST (Short-Throw), Medium, or Long Throw
- Mirrored or non-mirrored
- Lens Shift or None
  - Percentage Vertical Shift
  - Percentage Horizontal Shift
- Frustum/ Lens Cone type - this is the “0 position” of a lens versus the target surface. The home position of the lens is when there’s no lens shift capabilities or the lens isn’t shifted.
- Spherical Lenses - Specialized lenses (180 -270 degree throw) these projectors are used in planetariums, amusement park rides, and smaller dome projections.

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