Modeling of An Image Projection System Based on Panel-Type Display
Abstract

The modern display devices, e.g., liquid crystal display (LCD), are often used as the source for an imaging or projection system. Such display devices can be modeled conveniently by using the panel-type source in VirtualLab. As an example, an image projection lens is selected and analyzed with a panel-type source. The performance of the system is evaluated by both observing the spot grid in the image plane, and evaluating the angular/direction behavior.
Modeling Task

- Panel-type display
  - Wavelength: 532 nm
  - Resolution: $1024 \times 768$
  - Pixel pitch: 10 µm
  - Pixel aperture angle: 20°

- Projection lens system
  - Effective focal length: $f_{\text{eff}} = 11.44 \text{ mm} @ 532 \text{ nm}$
  - Lens design from USP 5625495

How to evaluate the quality of the imaging system at a certain distance behind the lens?
A well-designed projection lens system delivers an almost equidistant grid on image plane, with distortion under control.
Analysis in Angular Domain

- Panel-type display
  - 16 × 12 pixels selected out of 1024 × 768
  - Pixel pitch 10 µm
- Projection lens system
  - Effective focal length
    \( f_{\text{eff}} \approx 11.44 \text{ mm} @ 532 \text{ nm} \)
  - Lens design from USP 5625495

Analysis in angular/direction domain
Peek in VirtualLab

Panel source configuration

Lens system construction

Spot distribution visualization
VirtualLab Technologies

- prisms, plates, cubes, ...
- lenses & freeforms
- apertures & boundaries
- gratings
- waveguides & fibers
- scatterers
- diffractive beam splitters
- SLM & adaptive components
- micro lens & freeform arrays
- HOE, CGH, DOE
- nonlinear components
- free space

Channels:
- source
- detector

Mathematical notation:
- \((\rho, \omega)\)
- \(V^{\text{in}}(\rho)\)
- \(B\)
- \(V^{\text{out}}(\rho)\)
- \(\mathcal{F}_k\)
- \(\mathcal{F}_k^{-1}\)
- \(\rho\)
- \(\kappa, \omega\)
- \(\hat{p}\)
- \(\hat{p}\)
## Document Information

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