Data-Based Source [x-Domain]

Digital Twin Specification

Twin Code:	`SF-SDAT01`
Twin Name:	Data-Based Source [x-Domain]
Category:	Source
Type:	Function-Based
Version:	1.0
Package:	Platform
Last Updated:	`2026-03-25`

Description

The Data-Based Source [x-Domain] twin provides a flexible way to introduce custom light sources into your VirtualLab Fusion simulations. Instead of defining a source with analytical formulas, you load the complete electromagnetic field data—specifically a 2D data array containing both E_x and E_y components, along with the wavefront phase—from an external file or from a field calculated in another optical setup. This allows you to faithfully reproduce any arbitrary optical field, whether it originates from a complex simulation or from real-world measurements, and use it as the starting point for a new system.

Model Parameters

The twin is configured by providing the following data. All data must be defined on a consistent 2D grid (same sampling and number of points).

- **Electromagnetic Field**: A single 2D data array containing two subsets—one representing the E_x component and one representing the E_y component of the electric field in the spatial domain. This array fully defines the field's amplitude, polarization, and component-specific phases.
- **Wavefront Phase** $\psi(\boldsymbol{\rho})$: A real-valued array representing the common wavefront phase. This is the phase shared by all field components, typically arising from optical path length differences. If no wavefront phase is provided, a planar wavefront (constant phase) is assumed.

Note: The wavelength λ of the source is not part of the loaded field data. It is configured as a separate parameter in the source's spectrum settings (see Software Usage).

Simulation Model

From the provided E_x and E_y components, all other relevant field quantities can be derived to fully characterize the source. This ensures a complete and physically consistent electromagnetic field description for subsequent propagation through the optical system.

Typical Application Scenarios

1. **Cascading Optical Systems**: Use the output field from a complex simulation (e.g., light passing through a diffuser or a multi-lens system) as the input source for a subsequent optical system, enabling true multi-stage simulations.

2. **Importing Measured Beam Profiles**: Load experimentally measured beam data (amplitude and phase) into the simulation to analyze how a real-world beam will propagate through or interact with your optical design.

3. **Simulating Custom Laser Modes**: Create a source for a specific, non-standard laser mode by generating its field profile with an external tool (e.g., MATLAB, Python) and importing it for use in VLF.

Software Usage

1. **Prepare Field Data**: Obtain your electromagnetic field data (the combined E_x/E_y array) and the optional wavefront phase $\psi(\boldsymbol{\rho})$. This data can be:
   - **Imported** from an external file (ensure the format is compatible with VLF's data import tools).
   - **Calculated** in another VLF optical setup and captured using a `Field Monitor` detector, which can directly provide the wavefront phase.
2. **Add the Twin**: From the Digital Twin Hub, search for "Stored Source" or code `SF-SDAT01` and add the twin to your document.
3. **Load Field Data**:
   (a) Open the source's settings dialog.
   (b) Navigate to the **Spatial Distribution** tab.
   (c) Click the "`Set`" button next to the field data options.
   (d) Load your combined E_x/E_y array. If you have a wavefront phase array, load it in the designated field. If none is loaded, a planar wavefront is assumed.
4. **Set the Spectrum**: Go to the **Spectrum** tab in the source's settings and set the correct wavelength λ.
5. **System Integration**: Connect the source twin to other components (lenses, objects) and detectors to build your system and analyze the propagation of your custom field.

⚠ **Note:** The spectrum of the source is set in its settings. If the field you import into the source also has spectral information attached to it, it will be overwritten by the settings of the Stored Source [Databased].

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Related Twins:	DF-FMON01, SF-GAUS01, SF-GBES01