Channel Setting for Non-Sequential Tracing
Abstract

In VirtualLab Fusion, non-sequential tracing is enabled by adjusting the channels of each surface. This use case shows the definition of channels by using an example of a waveguide with two surfaces. Channels of each surface are adjusted and the consequences of the settings are shown. Furthermore, on a surface, grating regions can be defined. Setting of the region channels are not necessary to be identical with the surface channels. This use case shows how to set regions on a surface and how to adjust the channel configuration of a region.
Modeling Task

- how to adjust the channels on surface and region levels, and the consequences from these settings.
Surface Channels

- Initialization
  - Create a planar waveguide made of fused silica, with a thickness of 5mm, by using two plane interfaces without regions on them.
Surface Channels

- Initialization
  - Create a planar waveguide made of fused silica, with a thickness of 5mm, by using two plane interfaces without regions on them.
  - For better illustration, define an isolated Y-Axis Rotation of 30° for the waveguide.
Surface Channels

- Channel definition
  - There are four possible channels for each surface, at least one should be activated for the tracing.
  - Channels can be defined for each surface individually.
  - Different settings on channels leads to different tracing logic in VirtualLab.

<table>
<thead>
<tr>
<th>Channel</th>
<th>Description</th>
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<tbody>
<tr>
<td>+/-</td>
<td>transmission (forward)</td>
</tr>
<tr>
<td>+/-</td>
<td>reflection (forward)</td>
</tr>
<tr>
<td>-/+</td>
<td>reflection (backward)</td>
</tr>
<tr>
<td>-/-</td>
<td>transmission (backward)</td>
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Surface Channels

**Setting A**

<table>
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<tr>
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<th>+/+</th>
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<th>-/+</th>
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<tbody>
<tr>
<td>1st</td>
<td>×</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>2nd</td>
<td>×</td>
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**Setting B**

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**Setting C**

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<td>2nd</td>
<td>×</td>
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Surface Channels

Setting D

Note: an activated channel does not necessarily lead to corresponding light path(s). E.g., the 
/- and -/+ channel of 2\textsuperscript{nd} interface do not influence the tracing, because there is no backward incidence.
Region Channels

- Region(s) on surface
  - It is possible to define individual Regions on a surface and define their optical properties individually, including the channel settings.
Region Channels

• Region definition
  - Create a rectangular region on 1st surface.
  - Set the region size as 2.25mm × 2.25mm, and its center at -3.6mm along x-direction.
Region Channels

- **Region definition**
  - Create a rectangular region on 1st surface.
  - Set the region size as $2.25\text{mm} \times 2.25\text{mm}$, and its center at $-3.6\text{mm}$ along x-direction.
  - Define this region as grating with single transmission order $T_0 = 50\%$, and single reflection order $R_0 = 50\%$, which makes a semi-reflective mirror.

Efficiencies are given with respect to incidence from back side; in this example, $T$ and $R$ corresponds to $-/-$ and $-/+$. channels respectively.
Region Channels

• Region definition
  - Set up the channels for this region, following the same rule as for the surfaces.

Note: region channels provide individual control in addition to surface channels
Region Channels with Grating

- Region definition
  - It is possible to define a diffractive grating on a given region.
Region Channels with Grating

- Region definition
  - It is possible to define a diffractive grating on a given region.
  - We add a rectangular region (2.25mm side length) on 2nd surface, centered at -9mm along x-direction.
Region Channels with Grating

• Region definition
  − It is possible to define a diffractive grating on a given region.
  − We add a rectangular region (2.25 mm side length) on 2nd surface, centered at -9 mm along x-direction.
  − Define an ideal grating with 1 µm period, and specified diffraction coefficients as $T_0 = 10\%$, $T_1 = 60\%$, $T_2 = 10\%$. 
Region Channels with Grating

- Region definition
  - It is possible to define a diffractive grating on a given region.
  - We add a rectangular region (2.25 mm side length) on 2nd surface, centered at -9 mm along x-direction.
  - Define an ideal grating with 1 μm period, and specified diffraction coefficients as $T_0 = 10\%$, $T+1 = 60\%$, $T+2 = 10\%$.
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| further reading | - [Non-Sequential Ray Tracing Analysis of Glass Plate](#)  
- [Modeling of Etalon with Planar or Curved Surfaces](#)  
- [Optimizing Waveguide Outcoupling Gratings for Uniform Multiple Channels](#) |