**Compact Photonic Spot-Size Converters**

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**Optical chips**
- state-of-the-art photonic chip
- bends make up most of the surface
- 7 x 7 mm
- 64 channel selector (NTT)

**Adiabatic tapers**
- adiabatic tapers are normally used to connect waveguides with \( \neq \) cross-sections
- adiabatic: change slowly enough and your modes will follow (without loss)
- BUT adiabatic \( \Rightarrow \) very long

**Hybrid Waveguiding**
- compact waveguides (photonic wires or photonic crystal waveguides) allow very short bends
- BUT are rather lossy
- hybrid waveguiding can be a solution (compact waveguides for bends and splitters, broader waveguides for straight sections)

**Interference taper**
- new concept: interference coupler
- a sequence of waveguides sections with different widths and lengths are placed between in- and output waveguide
- optimization algorithms are needed to maximize the transmission

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**Genetic Search**
- \( N \) sections \( \rightarrow \) 2N-dimensional space to search
- find points \([W_1, \ldots, W_N, L_1, \ldots, L_N]\) with a good transmission
  - population of 100 individuals
  - initial population = random
  - selection = Roulette Wheel
  - cross-over = uniform, 50% chance
  - mutation = Gaussian curve around initial value
  - 100 best individuals survive

**Steepest Descent**
- starting point = discretized parabolic taper with decent transmission
- optimize \( W_i \) of each section (separately) using steepest descent, don’t alter \( L_i \)
- repeat \( n \) times
  - \( L_{new} = L_i \cdot (1 - \alpha) \)
  - optimize \( W_i \) of each section (separately) using steepest descent
- iterate until a certain break condition

**Measurements**

<table>
<thead>
<tr>
<th>Wavelength (nm)</th>
<th>Transmission (mW)</th>
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<tbody>
<tr>
<td>1500</td>
<td>0.000</td>
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<tr>
<td>1520</td>
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<td>1540</td>
<td>0.004</td>
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<td>1580</td>
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<tr>
<td>1600</td>
<td>0.010</td>
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<td>0.018</td>
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<tr>
<td>1700</td>
<td>0.020</td>
</tr>
</tbody>
</table>

**Linear Taper**
- \( 5 \mu m \)
- \( 10 \mu m \)
- \( 15 \mu m \)
- \( 20 \mu m \)
- \( 25 \mu m \)
- \( 30 \mu m \)
- \( 35 \mu m \)
- \( 40 \mu m \)
- \( 45 \mu m \)
- \( 50 \mu m \)
- \( 55 \mu m \)
- \( 60 \mu m \)
- \( 65 \mu m \)
- \( 70 \mu m \)
- \( 75 \mu m \)
- \( 80 \mu m \)
- \( 85 \mu m \)
- \( 90 \mu m \)
- \( 95 \mu m \)
- \( 100 \mu m \)

**Conclusions**
- shorter than adiabatic spot-size converters are necessary within optical chips
- an interference coupler optimized using different optimization algorithms can lead to decent results
- first measurements confirm simulated behavior and are very promising