Compact Photonic Spot-Size Converters

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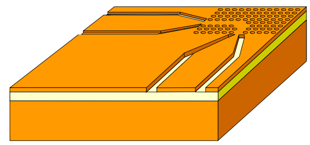
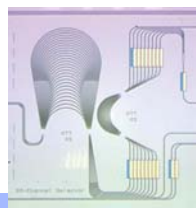
Optical chips

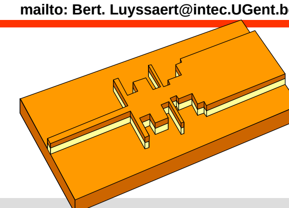
- state-of-the-art photonic chip
- bends make up most of the surface
- 7 x 7 mm
- 64 channel selector (NTT)





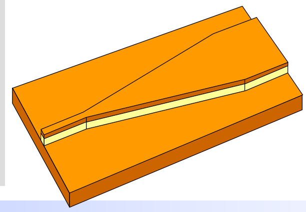
Adiabatic tapers

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



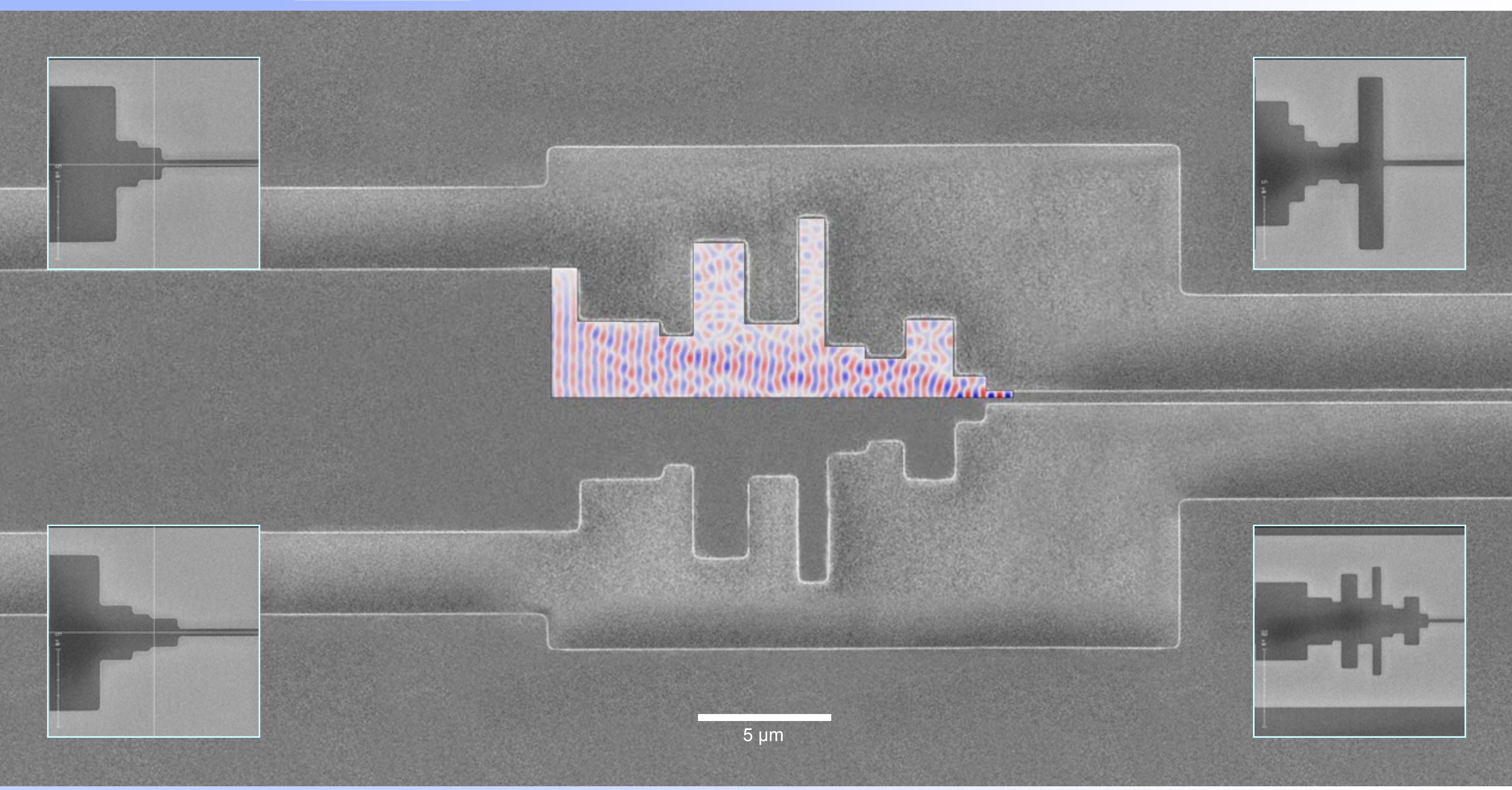
Hybrid Waveguiding

- compact waveguides (photonics 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)

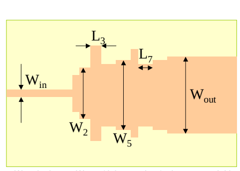


Interference taper

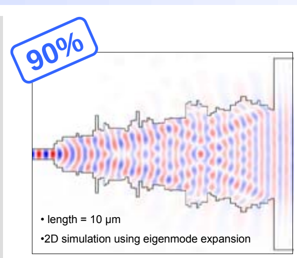
- new concept: interference coupler
- a sequence of waveguides sections with different widths and lengths are placed between in- and output waveguide
- optimization algorithms are needed to maximize the transmission



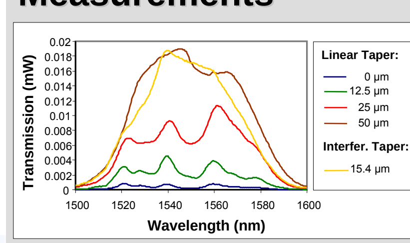
Genetic Search



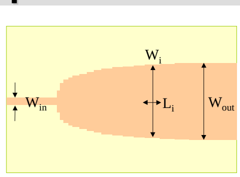
- N sections → 2N-dimensional space to search
- find points [W_1, …, W_N, L_1, …, L_N] with a good transmission
  - population of 100 individuals
  - initial population = random
  - selection = Roulette Wheel
  - cross-over = uniform, 50% chance
  - mutation = Gaussian curve around initial value
  -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

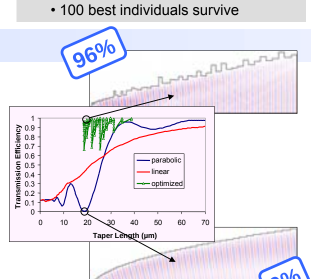


Measurements



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
- $L_{i,new} = L_i \cdot (1- a)$
- optimize W_i of each section (separately) using steepest descent
- iterate until a certain break condition

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