

Flat optics for miniaturization of LiDAR

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EPIC Online Technology Meeting on LiDAR Miniaturization

9 May 2022, 15:00-17:00 PM

Niklas Hansson

- Head of Application Engineering
- Gothenburg, Sweden
- Joined NIL Technology 2012
- General focus across DOE, MOE and MLA to find best optical solution for a given product




1. Manufacturing optical elements, components and modules

- Optical elements, **Rx and Tx**: diffusers, fanouts, collimators, focusing/imaging lenses; and building integrated functionalities
- Optical components and modules
- **Key technologies: DOE, MOE, gratings, MLA...**

2. Mastering technologies for diffractive waveguides

- **Masters (and working stamps) for VR/AR displays** to make diffractive planar waveguides



Copenhagen, Denmark (2006, HQ)

- Mastering
- Optics Design
- SCM
- Sales and Marketing
- Administration
- IPR

East coast, US

- Mastering

West coast, US

- Sales

Zürich, Switzerland


- Engineering
- Prototyping and manufacturing lines
- Process and product development
- Project management

Gothenburg, Sweden


- Mastering
- R&D

Other presence


- Ottawa, CA, sales
- Stockholm, SE, optics design




NILT, Copenhagen



70+ employees
20+ nationalities
≈50% w PhD degree

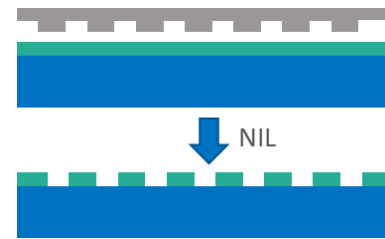
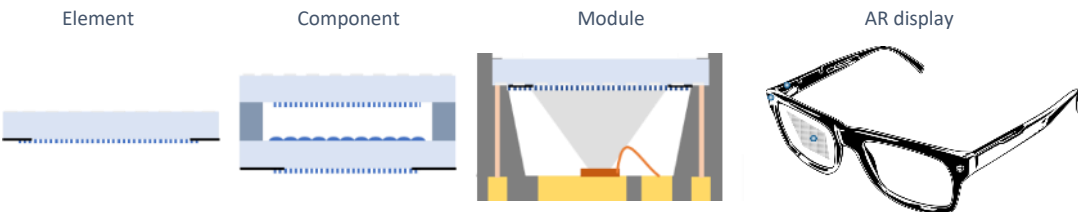


Production
Six class 10-100 cleanrooms
Unique lithography machines
In-house etching + EBL Q4-22



IPR
>60 registered inventions

Key technologies



Investors



Joltcapital **ngp capital**

VÆKSTFONDEN

European Innovation Council 

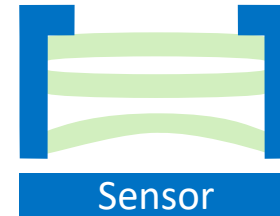
Swisscanto Invest
by Zürcher Kantonalbank

LiDAR Rx | Reduce TTL and use less elements

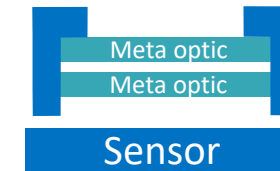
Telecentric system

Use MOE (Meta Optical Elements) to

- *Keep optical performance*
- *Reduce number of elements*
- *Reduce TTL*
- *Increase thermal stability – A MOE is about 10 times more thermally stable than a comparable refractive lens in glass*



Schematic receiver module



Schematic receiver module based on MOE

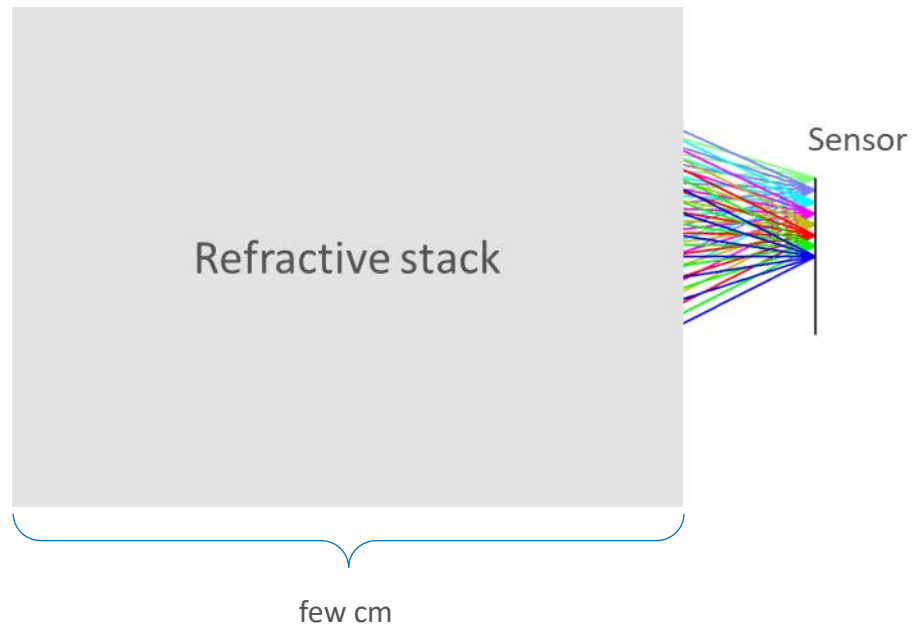
Limitations

- *Narrow band illumination required*
- *Size of the optics needs to be reasonable*

LiDAR Rx | How much can the system be scaled down?

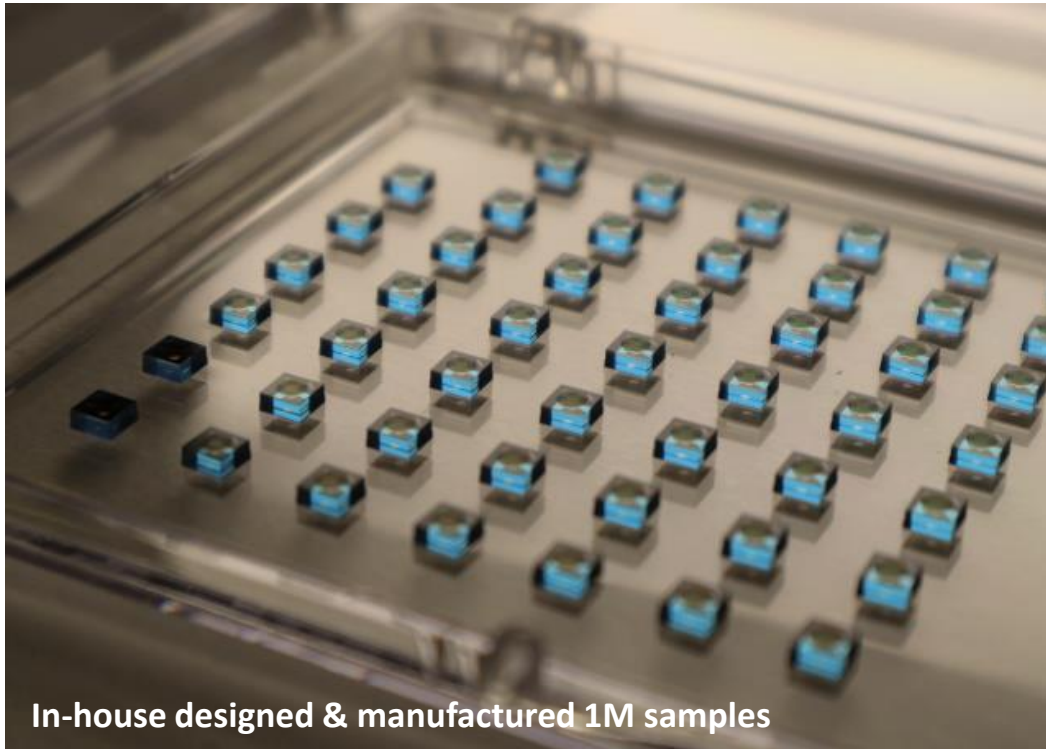
Real example

- Comparison of refractive solution and MOE solution
- Optical performance is in the same ballpark



Massive miniaturization with meta optics!

LiDAR Rx | MOE are manufacturable in volume

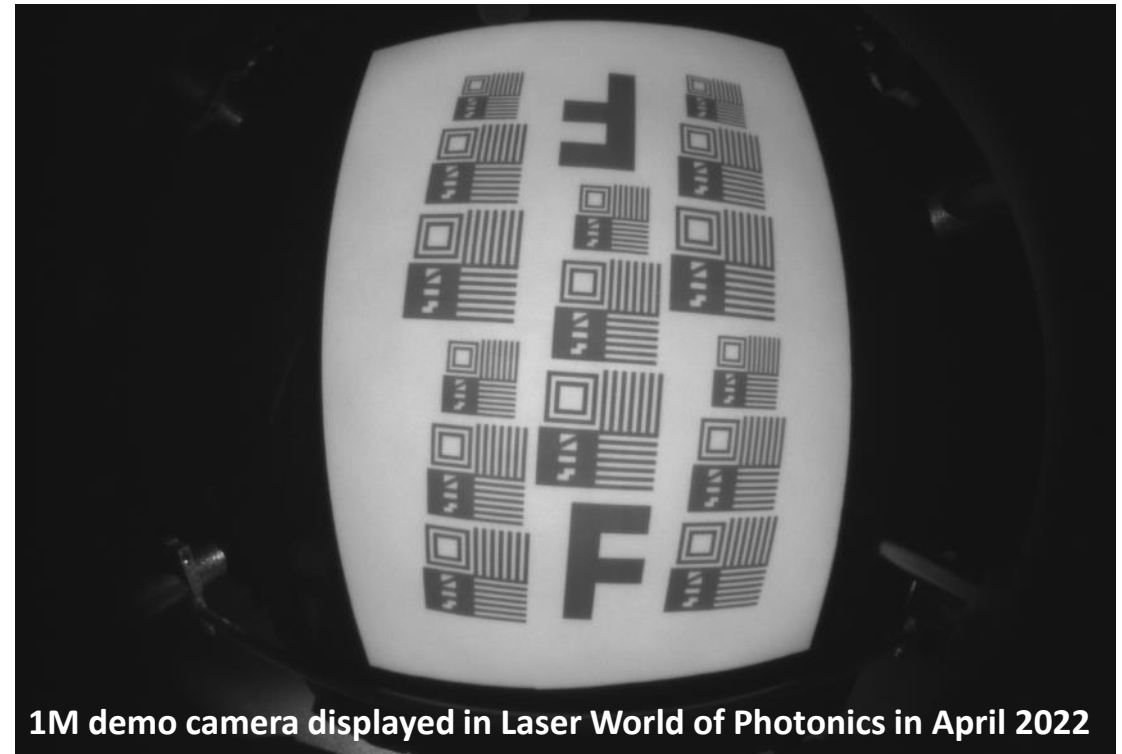


In-house designed & manufactured 1M samples

Parameter	Specifications
Wavelength	940 nm
EFL	1.24 mm
TTL	3.1
FOV, diagonal	80°
F/#	1.6
CRA	<1.5°
Distortion	23%
Aperture Diameter	0.78 mm
Lens Diameter	∅ 2.50 mm
BFL	1.213 mm

Lens MTF (Average Sag/Tan)
Nyquist = 227 lp/mm

0.0 F = 0.75
0.5 F = 0.74
0.8 F = 0.71



1M demo camera displayed in Laser World of Photonics in April 2022

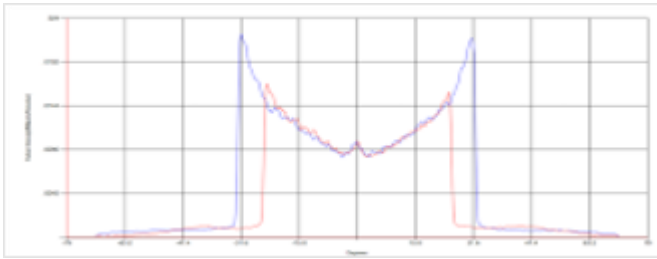
1M = High performance with only 1 optical surface

- 90% efficiency
- Telecentric, high RI design
- Good performance match between realized prototype and design
- Designed, prototyped and characterized inhouse
- Samples available

LiDAR Tx | Increase dot uniformity & tailor illumination profile

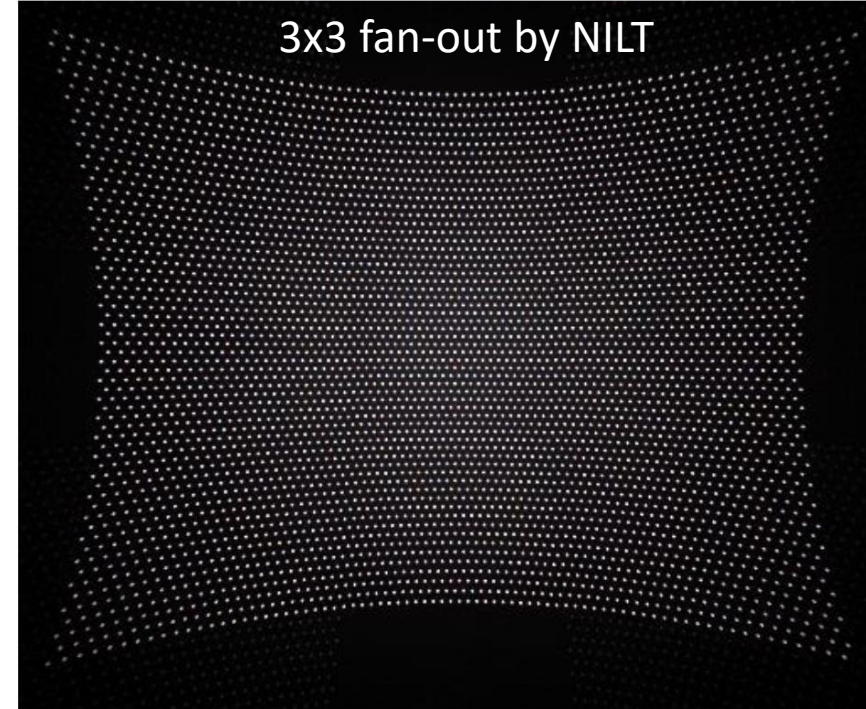
Scanning LiDAR - Line illumination

- Tailor illumination profile with DOE to counter drop in relative illumination



Flash LiDAR

- Increase uniformity and efficiency of the dot projection



- High efficiency (>94%)
- High control of dot uniformity (<10%)
- Fan-outs can be tailored to fit customers existing VCSEL and collimation system



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