Optical beamformers for phased array antenna systems

Integrated Microwave Photonic Systems

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Los Angeles, CA, USA
• Founded in Enschede December 2009
  Mesa+ / University of Twente spin-off
• Design & Manufacturing of innovative microwave photonics components and beam forming networks
• Applications: communication, observation, security & smart networks

Company Introduction

Dr. Paul van Dijk
CEO

Dr. Chris Roelofzen
CTO

Dr. Ruud Oldenbeuving
Project Leader

Dr. Roelof B. Timens
Product Engineer

MSc. Ilka Dove
System Engineer
Integrated Microwave Photonics
Processing of Broadband Radio Signals in Photonic Integrated Circuits

Wideband, reconfigurable RF signal processing PICs for advantage in size, weight and power
Beamforming principle

Input signal 10.7-12.75 GHz

Laser

Optical carrier

DSB-SC 2x10.7 GHz

True-time delay

Optical sideband filter

Carrier re-insertion path

Balanced detector

RF out

Coherent detection
TriPleX™ waveguide technology

- Low coupling loss to single-mode fiber
- Low waveguide loss
- Small bend radius
- CMOS-compatible fabrication process
- Complex structures

Cores: Si$_3$N$_4$  Cladding: SiO$_2$

Waveguide propagation loss (dB/cm)

Bend radius (µm)

L. Zhuang et al., Optics Express, 19(23), 23162-23170 (2011)
Antenna pattern measurement for Astronomy

For radio astronomy application (SKA)

ASTRON

Burla et al., *IEEE MWP* 2010, Montreal.
Integration of active and passive (InP and TriPleX)

- Laser light in Optical carrier
- 16 x RF in InP Modulator array 10 GHz
- TriPleX: 16 x 1 Optical beamforming
- 2 cm
- To RF photodiode
RF & Photonic integration
A fully integrated broadband optical beamforming module
Microwave photonics is required to make disruption in RF processing

RF and photonic integration is imperative to yield a reliable beamformer

TriPleX™ Si₃N₄/SiO₂ waveguide technology enables low loss, compact, stable, mass producible MWP signal processors

InP enables integration of light sources, modulators, detectors

Next step: Hybrid integration of InP and TriPleX™ Si₃N₄/SiO₂

Vision: Towards iMWP (0-40 GHz, Phase shifting, True time delay, Multi beam, Combining, Splitting, FIR, IIR, RF-in, RF-out)
System requirements define the components

- TriPleX available through: MPW and dedicated runs since 2009
- InP available through: Paradigm 2009, ActPhast 2014, JePPIX

- Fiber array – Chip: up to 32 fibers, interface loss < 1 dB
- InP - TriPleX: edge coupled. Targeted interface loss < 1 dB
- Electronic interfacing DC and RF: Wire bond between PIC and PCB

Do call us
Don’t hesitate
Thank you for your attention

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