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UltrasoundToGo RTD 2013

FNSNF

ETH zürich

Active Ultrasound Transducer Heads

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1. Introduction

Project Goal: Development of a **high-performance**, **low-power** signal processing platform for **ultrasound imaging,** targeting future 3D **portable ultrasound** systems.

3D ultrasound systems can achieve ...
- volumetric measurements
- fast motion capture (e.g., of heart valves)
- separation of acquisition and interpretation

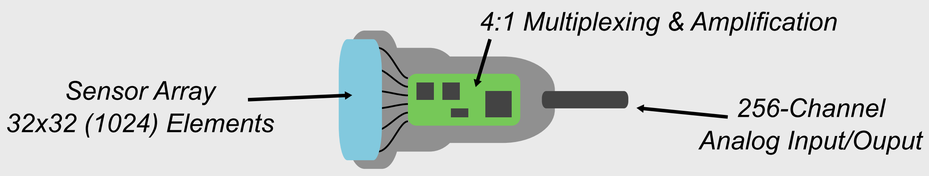
... but require **large matrices of transducer elements (>32x32)** to capture the required raw data for volume reconstruction.

Connecting **all (>1000) elements** individually over a cable to the backend processing system requires an untangible amount of microcoaxial cables, which would result in a **bulky and unergonomic cable harness**. Thus, any ultrasound probe designed for 3D requires **some sort of preprocessing** in the transducer head in order to facillitate the cable design.

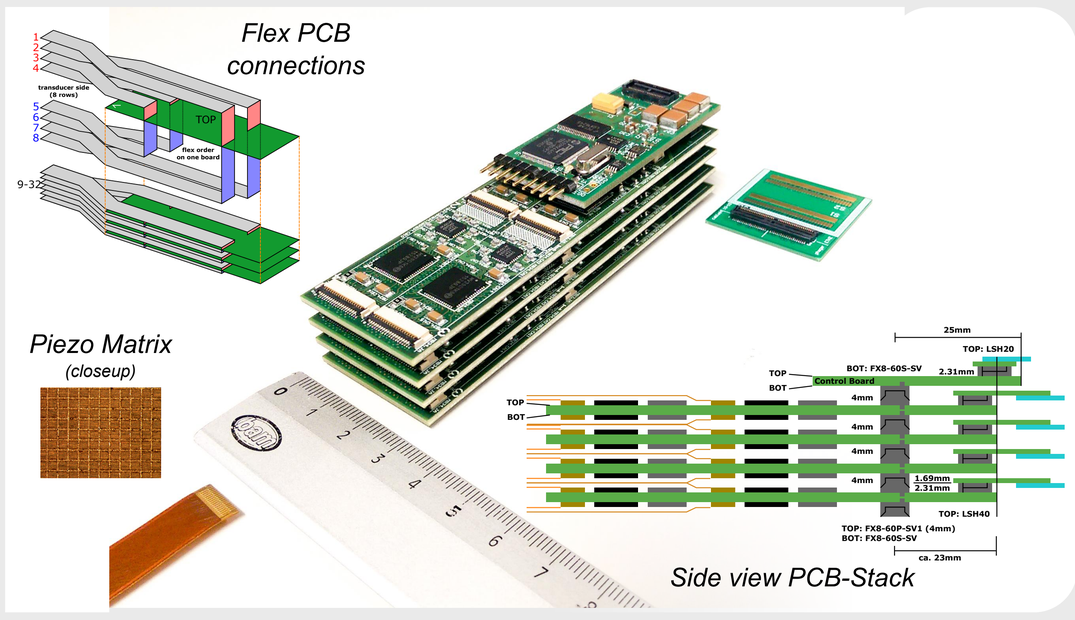
2. The MUX-Head

Getting a 3D Ultrasound Transducer Head for Ultrasound2Go

Problem: 3D-capable transducer heads are available for commercial high-end systems but not for research systems. Details about interfaces and functions of these commerical heads are kept secret.
> An open 3D-capable transducer head is required for the project, which can be connected to an ordinary research system.



Design based on a exisiting prototype in collaboration with Fraunhofer Institut für Biomedizinische Technik (IBMT) in St. Ingbert.



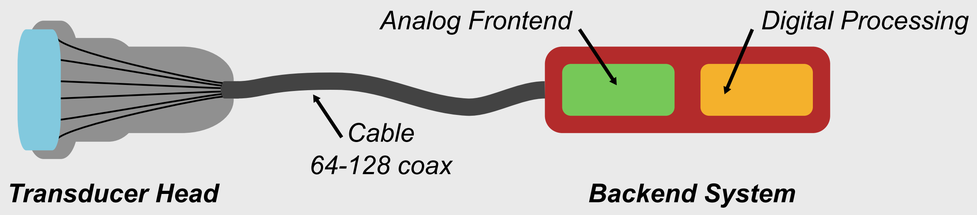
Compared to the existing prototype, the volume of the stack was reduced by **2x** and the area of the cross-section by **3x** to 30x33mm.

3. The LightProbe

NextStep Collaborative Project
with Fraunhofer IBMT & Active Technologies

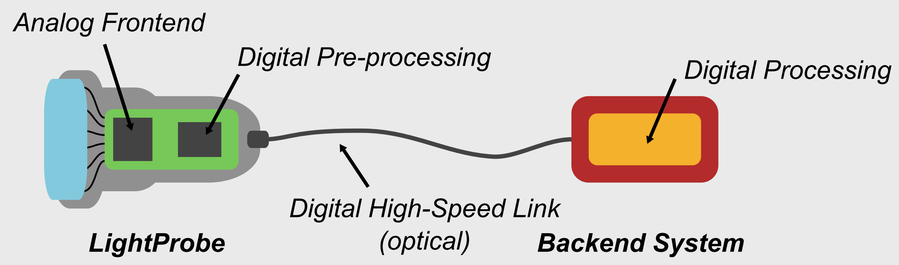
Design of a Miniaturized 2D Digital Ultrasound System

Conventional Ultrasound System:



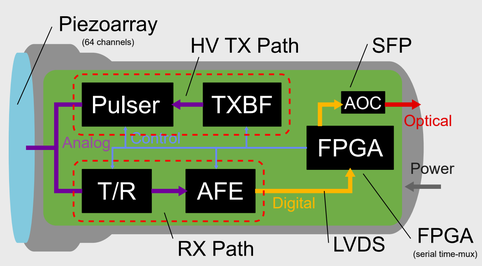
The transducer head is connected over an **expensive micro-coaxial cable harness** to the backend system.

LightProbe System:

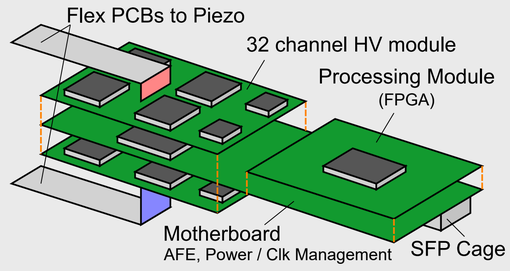


The analog frontend is moved into the transducer head. Pre-processed **digital samples** are sent over an **optical digital link** to a backend processing system. All ultrasound-specific hardware is concentrated in the transducer head (LightProbe), which can be connected to a **commodity processing platform** over a standardized interface.

LightProbe Design



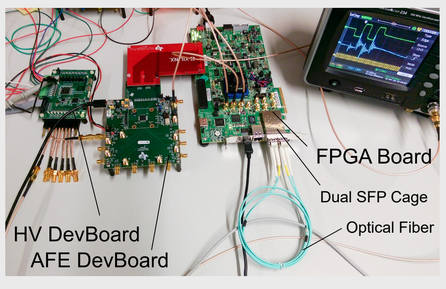
LightProbe Block Diagram



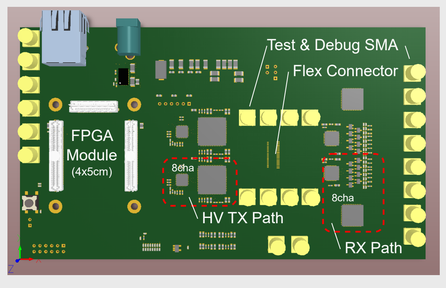
LightProbe PCB Stack

The LightProbe incorporates a **linear 64-channel piezoarray** (by *Fraunhofer IBMT*), a **TX-path** to emit ultrasound pulses, a **RX-path** to record the echos, a small **FPGA** for preprocessing and control, and an **optical interface** connector - all to be packed in a small form-factor.

Intermediate Project Stages



System Design
Component Evaluation



Intermediate Demonstrator
32-channel / reduced density
for functional evaluation

The LightProbe provides a **modular development platform** for future ultrasound system research targeting mobile low-power systems.

4. Outlook

- Attach the MUX-Head to the **UltrasoundToGo processing system**
- Combine LightProbe with MUX-Head for **digital 3D ultrasound head**
- Replace processing module in LightProbe with future developed ultrasound processing ASICs to support new modalities
- Connect LightProbe to commodity hardware like a Nvidia Tegra tablet