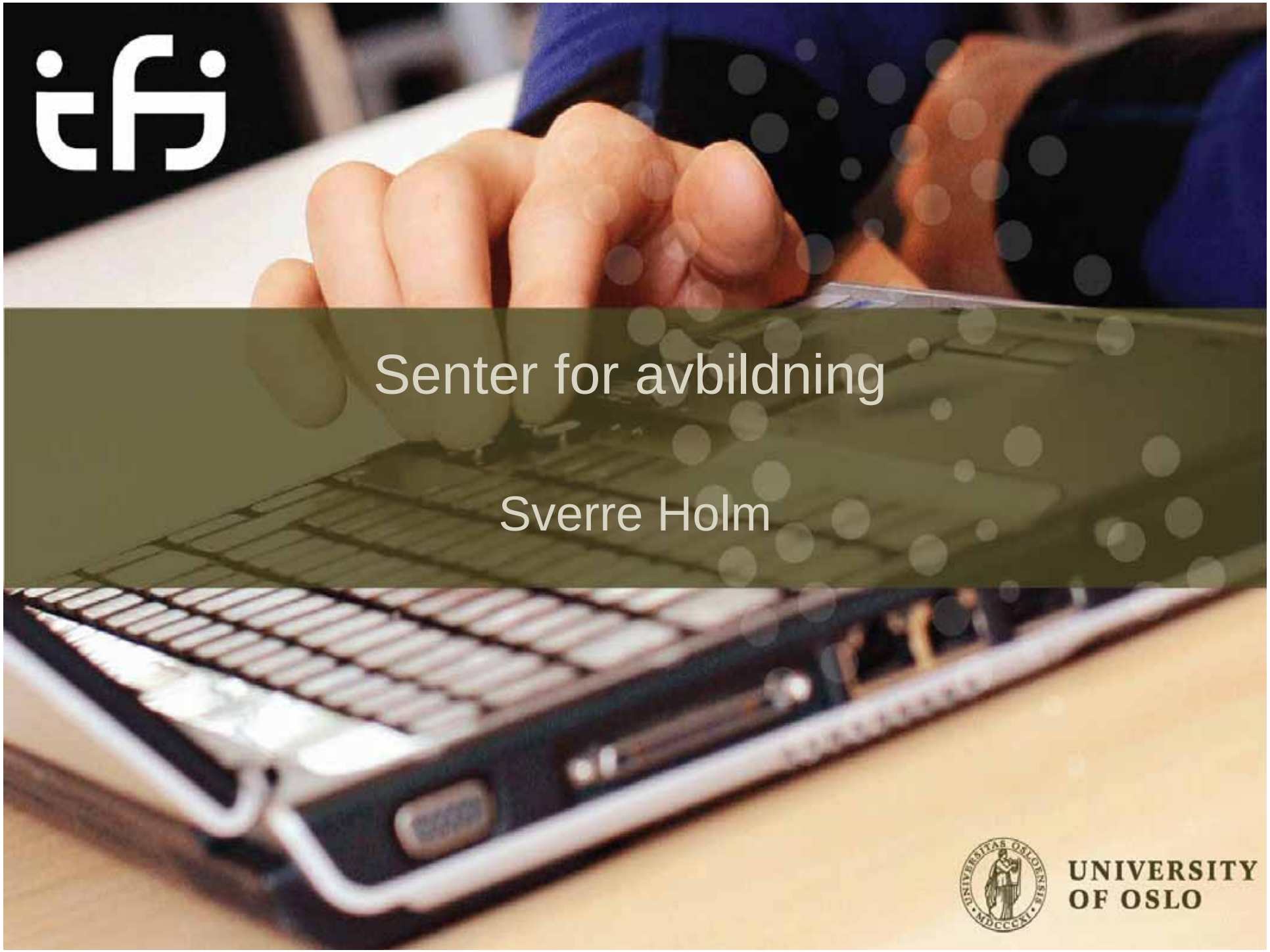
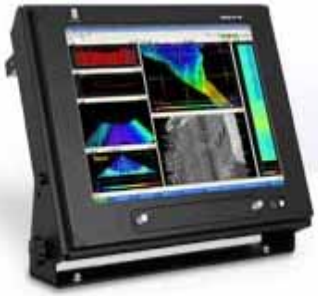

Senter for avbildning
Sverre Holm
UNIVERSITY
OF OSLO

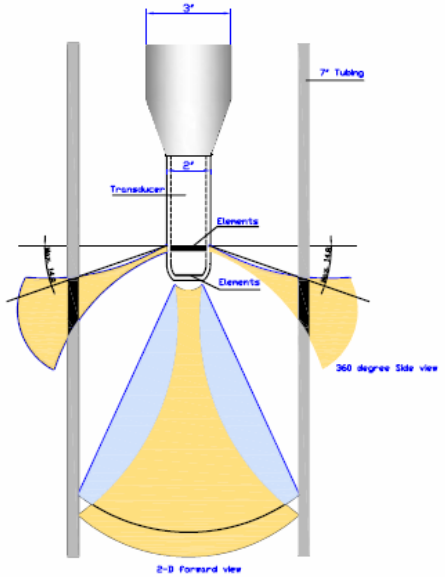
Sonar - Ultrasound Imaging

- University of Oslo
  - Faculty of Mathematics and Natural Sciences
    - Department of Informatics
      - Group for Digital Signal Processing and Image Analysis: http://www.ifi.uio.no/dsb/
- About half the group in ultrasound/sonar imaging:
  - 2 Permanent positions + 1 Post Doc + 4 PhD students
  - out of a total of 5 permanent, 2 Post Docs, 7 PhD students
- Centre for imaging: http://www.ifi.uio.no/sfa/ (joint with geophysics department)
- Acoustics/ultrasonics lab

Collaboration with Kongsberg Maritime and Norwegian Defense Research Establishment on new sonars



Worked with GE Vingmed Ultrasound on improved medical ultrasound imaging



TecWel WPE: Well Performance Eye with Norbit. Partly financed by Statoil LUP (leverandør-utviklingsprogrammet)

Related Activities

- Companies started by employees or former students:
  - VivID - Passive ID tags for use in liquids (MEMS)
  - Squarehead Technology - Zoom audio system for sports events
  - Elliptic Labs - Touchless human/machine user interface for 3D navigation (ultrasonics)
- Real Time Location Systems – Acoustic Communications

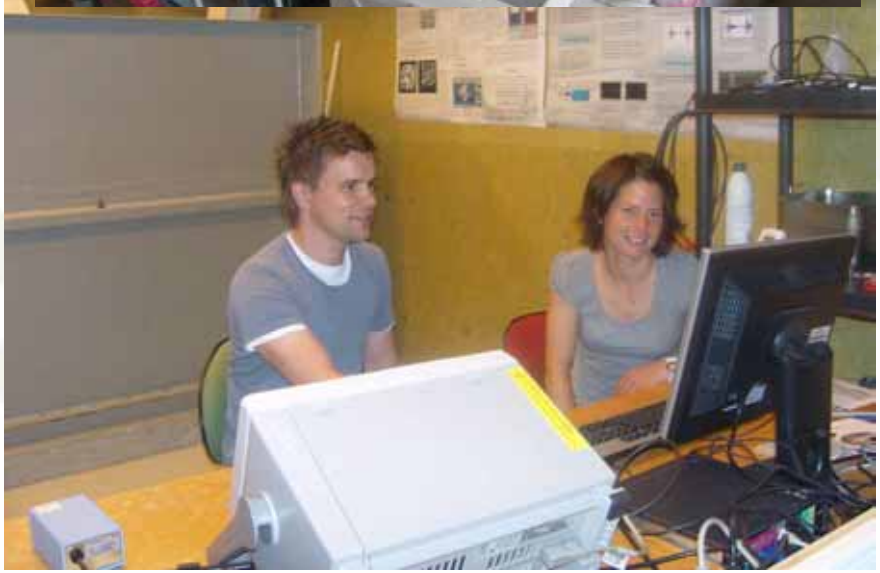
High resolution imaging and beamforming

- NFR - KMB
- Duration: 01.07.2007 - 30.06.2011
- Participants
  - Department of Informatics, UiO
  - Kongsberg Maritime
  - Squarehead Systems
  - Norwegian Defense Research Establishment
- Extent
  - 2 PhD's
  - 1 Postdoctor
  - Sonar laboratory
- Budget
  - NOK 7.7 mill in total

High resolution imaging and beamforming

- The project aims at providing new knowledge in the field of imaging and beamforming for acoustic applications.
- The research shall be firmly established in real world data and thus based on measurements in the laboratory and on data from field experiments.
- The goal of the project is to contribute to new and/or improved forms of sonars and other acoustic systems by researching the following ideas:
  - Investigate and adapt high resolution beamforming to sonars and acoustic monitoring
  - Investigate and exploit non-linear acoustics for harmonic imaging in sonar
  - Investigate diffraction arrays for use in sonars and hydroacoustic positioning and monitoring
  - Explore vector sensors and investigate their potential for use in underwater acoustics

Ultralyd/sonar-lab

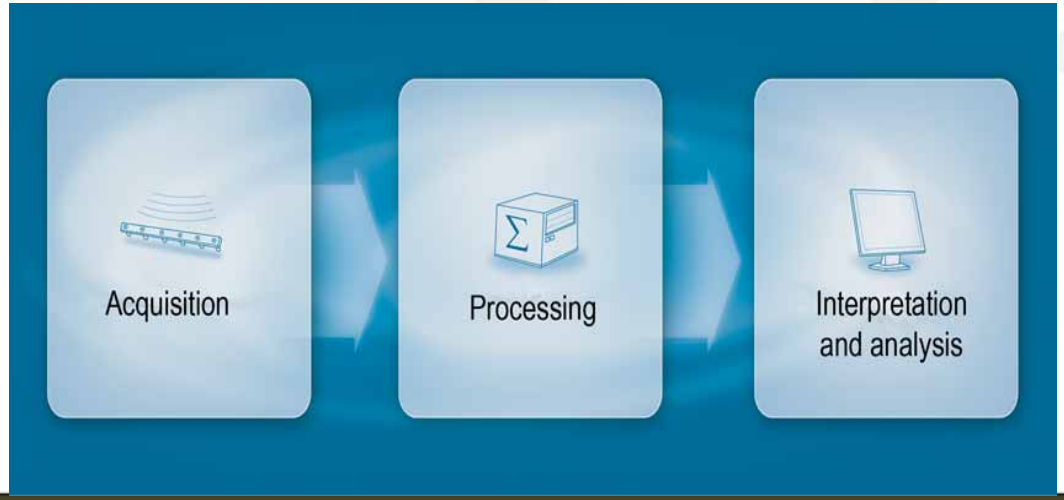


YouTube

- Ultrasound-based thermometer
- http://www.youtube.com/watch?v=bSaEP9sVolE
- Theremin controlled by ultrasound rangefinder
- http://www.youtube.com/watch?v=TaYXDDcYVZM

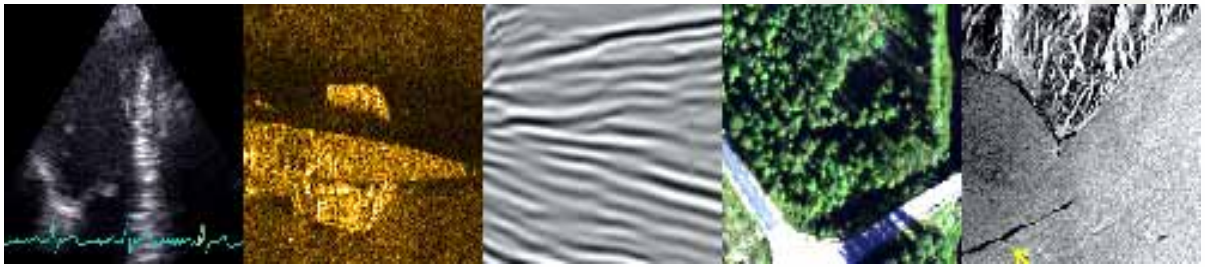
Acoustic image formation and interpretation - ACIM

- SUP- prosjekt 2008-2011 (Strategisk)
- Partnere:
  - Gruppe for digital signalbehandling og bildeanalyse, IFI
  - Institutt for geofag
- Omfang: 7.5 MNOK, 2 Ph.D., 1 Post.doc



ACIM: Main goals

- To demonstrate the potential of integrated image formation/interpretation on sonar and seismic imaging.
- To develop new, efficient and accurate iterative seismic imaging methods for the special case of salt tectonics.
- To develop new sonar image analysis techniques in conjunction with refinement of enhancement techniques for sonar image feature extraction



Available online at www.sciencedirect.com
ScienceDirect
Aquacultural Engineering 36 (2007) 122–126
aquacultural engineering
www.elsevier.com/locate/aqua-online

Acoustic passive integrated transponders for fish tagging and identification

Sverre Holm [a,*], John Brungot [b], Arne Rønnekleiv [c], Lars Hoff [d], Vibeke Jahr [e], Kai M. Kjølerbakken [e]

[a] University of Oslo, Oslo, Norway
[b] VivID AS, Ås, Norway
[c] Norwegian University of Science and Technology, Trondheim, Norway
[d] Vestfold University College, Borre, Norway
[e] Squarehead Systems, Oslo, Norway

Received 1 February 2006; accepted 10 September 2006

Abstract

The objective of the experiments reported here has been to develop a fish tag, which is as cheap and simple to insert as the coded wire tag and which has the remote readout capabilities of the radio frequency (rf) based passive integrated transponder (PIT) tags. The acoustic PIT tags are made using MEMS (micromachined electro-mechanical system) technology and readout is based on ultrasound waves, which propagate with relatively low losses in saline waters. The passive microchip tag responds with a combination of specific resonance signals to an interrogative ultrasound signal.

The system was first tested in the laboratory with satisfactory results. During the last trials the tag was injected into the abdomen of anesthetized fish, causing no reduction in readout signal quality compared to free tags in water. The tested chips had five resonance cavities at different frequencies in the range 100–400 kHz. Although there were some variations from wafer to wafer in the initial production runs, we observed precise resonance peaks at the expected frequencies and with good repeatability.

The results indicate that it is possible to develop a low-cost system for underwater identification of fish suitable for a high automation level. This could open up for improvements of logistics in for instance the fish farming industry.

Keywords: Fish tagging; Fish identification; Ultrasound; Microchip; Traceability

Setup

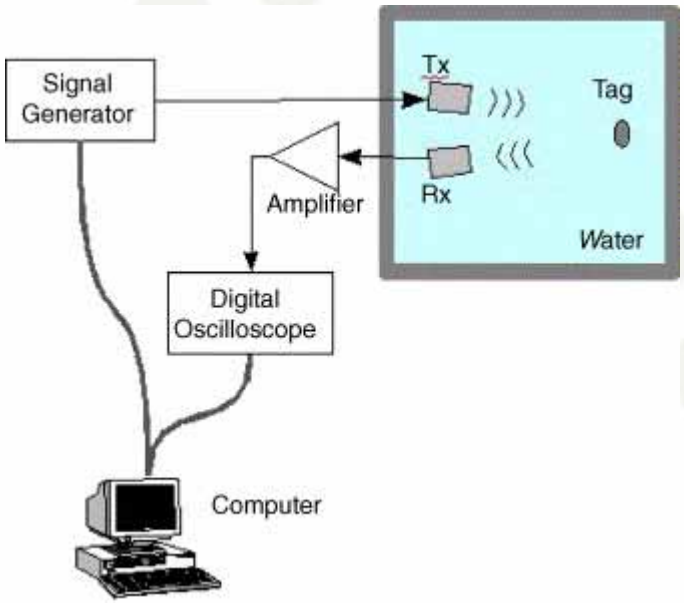
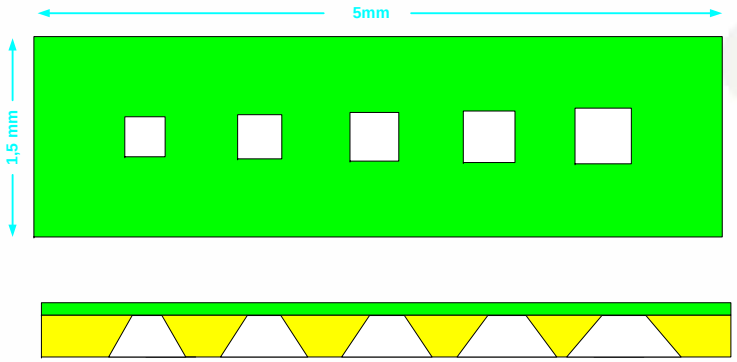
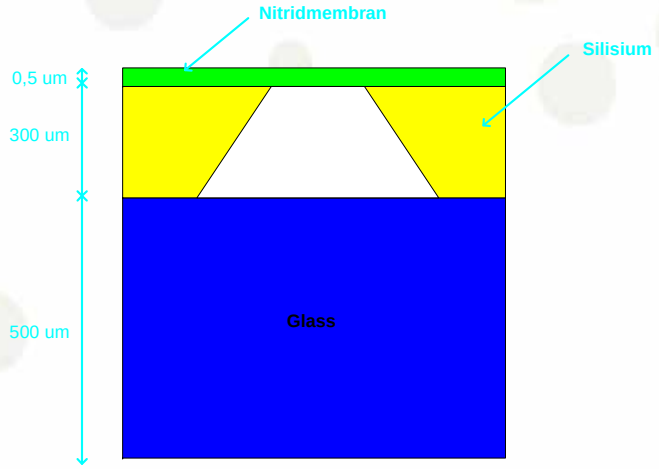


Fig. 1. The experimental set-up including transmit (tx) and receive (rx) transducers.

MMS: Mikro Mekanisk System

- Identifiseringsbrikker laget av silisium med 5 små membraner (SINTEF)
- Membranene er laget ved å våt-etse kaviteter gjennom en silisiumskive til etsen stopper mot en nitridmembran
- Skiven festes så til en glasskive ved hjelp av anodisk bonding.





Measured frequency responses

Fig. 2. Normalized frequency response for echoes received from a single ID tag.

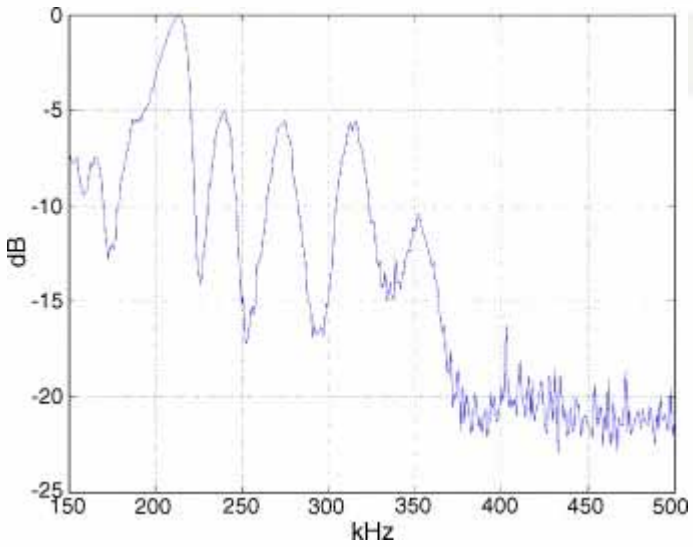
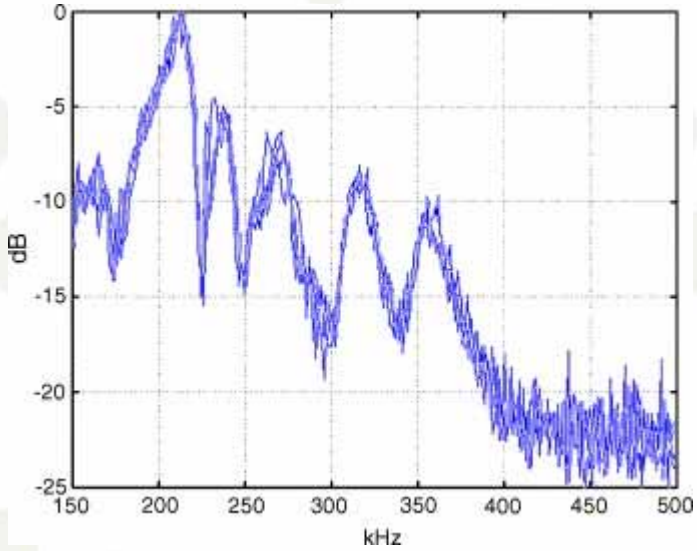
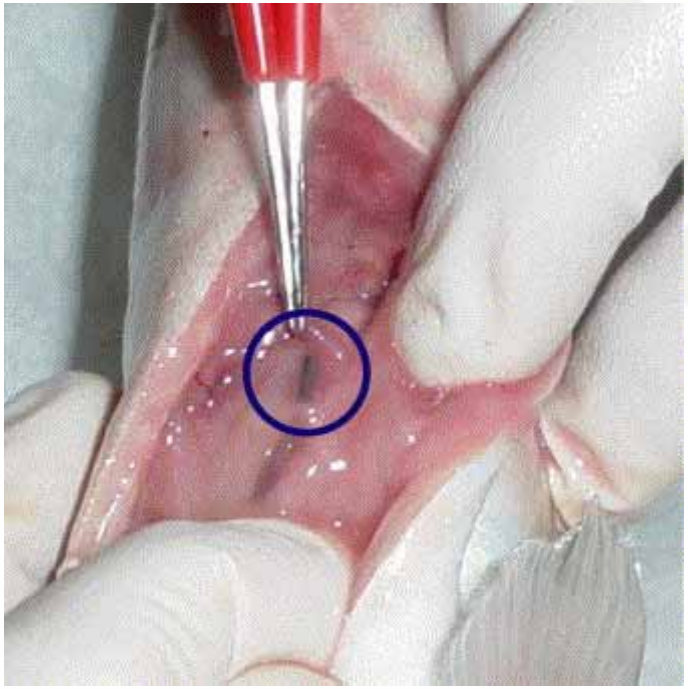


Fig. 3. Overlaid frequency responses from four measurements on the same ID tag in the same position.



Chip inserted in abdomen of fish



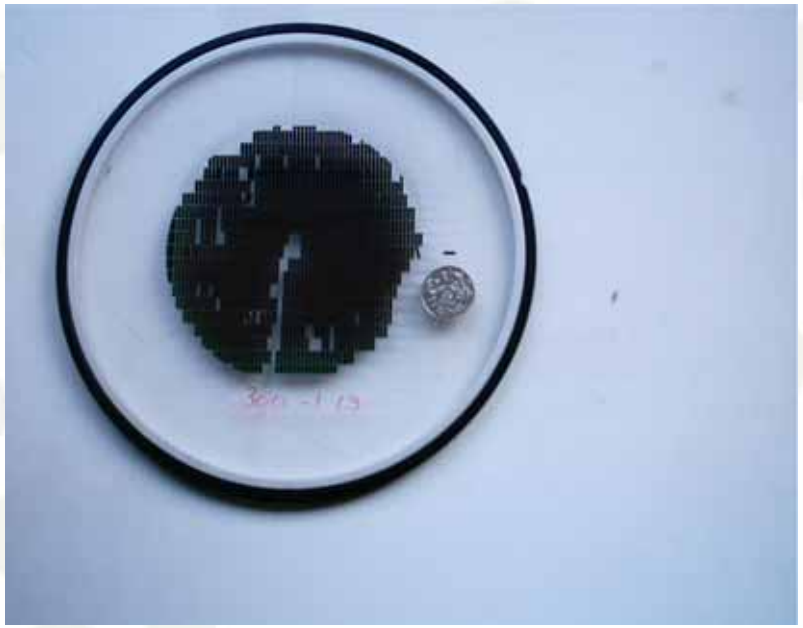


Fig. 4. Chip in the abdomen, location is just below the tool tip.

Back-scattered signal

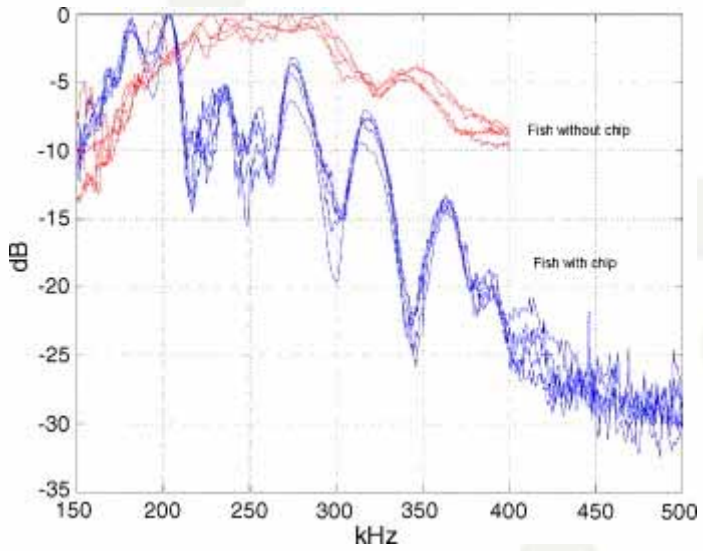
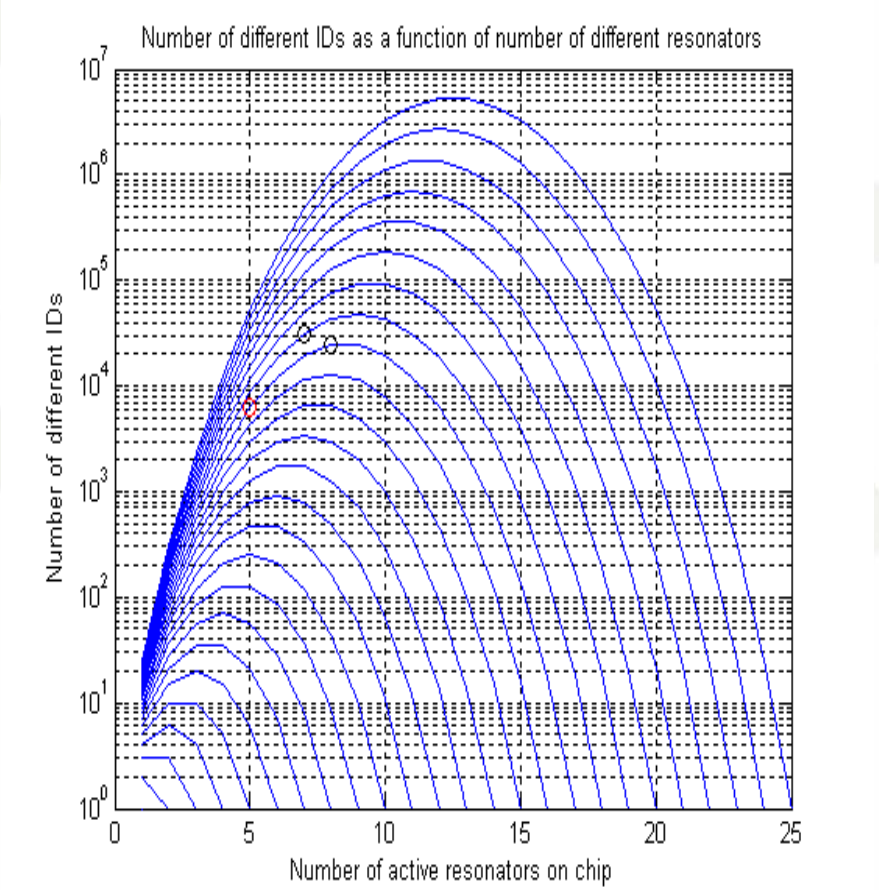


Fig. 5. Scattered signal from the fish with ID chip (lower curve) and fish without ID chip (upper curve), all normalized to 0 dB peak level.

Antall ID-er

Designvariabler:

- Totalt antall mulige resonans-frekvenser/ resonatorer
- Antall resonatorer på hver brikke



Conclusion

- We have developed and demonstrated the feasibility of a passive ultrasound fish tagging system. The tag is small, and made by silicon micromachining techniques, and hence potentially cheap. The tag operates in the 200–400 kHz range, and its identity may be read by detecting the resonance frequencies of acoustic resonators present on the tag. There was acceptable agreement between resonance frequencies and the analysis. We have shown that echoes from the tag may be detected both in water and in fish.
- The measurement arrangement and speed have been much improved during our experiments. With the initial measurement system, measurements on fish in movement were not feasible, but with the strongly reduced measurement cycle (1–2 ms), in combination with electronic focusing and multi-beam signals we can now meet this challenge.
- NFR, Innovasjon Norge
- SINTEF