Management of fisheries in harbour porpoise (Phocoena phocoena) marine protected areas

The harbour porpoise (Phocoena phocoena) is the focus of a range of conservation efforts and policies aiming at reducing bycatch of the species in gillnet fisheries. In European waters, the harbour porpoise is protected within the Habitats Directive (Annexes II and IV), implying that the population has to be maintained at a favourable conservation status and the deliberate actions of killing and disturbance and habitat deterioration shall be prohibited in accordance with the directive’s aims. A spatial network, Natura2000, will further protect all Annex II species. According to Natura2000, Member States are obliged to nominate candidate protected areas in their waters to the EU Commission and within six years establish legislation to implement them as special areas of conservation and prepare management plans. Up to this point in time, however, no such management plans exist. This Ph.D. thesis focuses on research methods and management tools, which can contribute to a better scientific understanding in the preparation of fisheries management plans for Natura2000 sites designated for harbour
porpoises. Firstly, it investigates the potential use of CCTV cameras to document bycatch of marine mammals. Here it is shown that Remote Electronic Monitoring (REM) systems installed on commercial fishing vessels can provide video footage, time and position of all net hauls and record bycatches of marine mammals. Comparisons between the visual analysis of the REM data and fishers logbooks showed that the REM system gave more reliable results since fishers did not, in many instances, observe the bycatch while working on the deck because it dropped out of the net before coming on board. Furthermore, REM provided high percentage coverage at low cost, compared to on-board observers. Secondly, the suitability of using high-resolution spatial and temporal data on porpoise density and fishing effort data from the Danish Skagerrak Sea as a method to predict harbour porpoise bycatches was examined. The results showed that a simple relation between the two could predict bycatch and that the final model can thus be used as a tool to identify areas of porpoise bycatch risk and thereby support the management of both fisheries and harbour porpoises in accordance with the Habitats Directive. Thirdly, the behaviour of porpoises in relation to two different pinger types with different acoustic properties was studied at three different locations. The results showed that at one location, the AQUAmark100 pinger had a significant effect on porpoise echolocation behaviour at 0 and 200 m distances, whereas another trial showed a significant reduction in such behaviour for up to 400 m. In none of the studies of the AQUA100 did the behaviour reveal any signs of habituation. Studies of the AQUAmark300, however, revealed clear habituation effects. Fourthly and finally, the thesis describes the governance process and analyses its mechanisms and conflicts surrounding ongoing fisheries management planning with a focus on two Natura2000 sites in the Danish part of the Skagerrak Sea designated to protect harbour porpoises.
the light dredge was significantly less (177.1 vs. 202.7 kg m⁻¹). In the twin haul experiment no significant difference was found in the catch per unit effort (CPUE) of the two gears. The single dredge experiment, on the other hand, demonstrated a significant increase in CPUE exceeding 200% when using the light dredge. Seafloor tracks made by the two dredges could not be distinguished by use of side-scan sonar and the tracks were still detectable 2 months after fishing. It was concluded that replacement of the Dutch dredge with the light dredge would reduce the impact of the fishery on the ecosystem by (i) reducing resuspension of sediment, (ii) reducing fuel consumption, and (iii) potentially reducing energy transfer to the sediment through a reduced gear drag resistance. A potential increase in catch efficiency may reduce the area affected. Fishing with the light dredge is discussed in relation to management of Natura 2000 sites.

**General information**

State: Published
Organisations: National Institute of Aquatic Resources, Section for Ecosystem based Marine Management, Danish Shellfish Centre, Section for Marine Living Resources, Section for Maritime Service, NIRAS A/S, Orbicon
Authors: Frandsen, R. (Intern), Eigaard, O. R. (Intern), Poulson, L. K. (Ekstern), Tørring, D. B. (Intern), Stage, B. (Intern), Lisbjerg, D. (Intern), Dolmer, P. (Ekstern)
Pages: 162-173
Publication date: 2015
Main Research Area: Technical/natural sciences

**Publication information**

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Volume: 25
Issue number: 2
ISSN (Print): 1052-7613
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BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): SJR 1.203 SNIP 1.255 CiteScore 2.79
Web of Science (2017): Indexed Yes
BFI (2016): BFI-level 1
Scopus rating (2016): CiteScore 2.5 SJR 1.189 SNIP 1.038
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 1.087 SNIP 1.021 CiteScore 1.98
Web of Science (2015): Indexed yes
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 1.013 SNIP 1.195 CiteScore 1.99
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 1.139 SNIP 1.028 CiteScore 1.95
Scopus rating (2012): SJR 1.069 SNIP 1.147 CiteScore 2.15
Scopus rating (2011): SJR 1.178 SNIP 1.099 CiteScore 1.97
Scopus rating (2010): SJR 0.929 SNIP 0.974
Scopus rating (2009): SJR 0.834 SNIP 0.894
Scopus rating (2008): SJR 1.07 SNIP 1.224
Scopus rating (2007): SJR 0.811 SNIP 0.932
Scopus rating (2006): SJR 0.841 SNIP 0.903
Scopus rating (2005): SJR 0.82 SNIP 0.991
Scopus rating (2004): SJR 0.734 SNIP 1.32
Scopus rating (2003): SJR 0.616 SNIP 0.676
Scopus rating (2002): SJR 0.509 SNIP 0.585
Scopus rating (2001): SJR 0.586 SNIP 0.748
Scopus rating (2000): SJR 0.444 SNIP 0.752
Scopus rating (1999): SJR 0.574 SNIP 0.921
Original language: English
DOIs:
10.1002/aqc.2455
Publication: Research - peer-review › Journal article – Annual report year: 2014
In-situ identification of marine organisms using high frequency, wideband ultrasound

Reliable remote fish identification would be an important improvement in resource management as well as in commercial fishing. Optical and acoustical methods could be used either in combination or separately. However, the acoustical methods have better detection ranges than any known optical methods. Conventional acoustical methods use frequencies in the range of 10 to 500 kHz and give reasonable estimations of size distribution, if the species is known, but can only significantly support the determination of the actual species, if there are only a few known species available. It is expected that higher frequencies and broader bandwidths than used until now will give more information useful for fish species identification.

The objective of this Ph.D. study has been to develop a method to investigate the possibility of in-situ identification of fish with high-frequency, wideband ultrasound. The approach was to build a 1 MHz wideband single-element transducer system to obtain range profiles of fish, and to do fish species identification by comparing measured range profiles with libraries of reference range profiles as it is done in some radar systems used to identify aircraft. To do this, it is also necessary to investigate the properties of ultrasound backscatter of fish in the MHz frequency range to help the interpretation of the range profiles. Three case studies were investigated in this Ph.D. study.

The first case study was to investigate the ultrasound backscatter of fish in the MHz frequency range using empirical methods. Measurements using a BK Medical ultrasound scanner equipped with a dedicated research interface were performed on a saithe (Pollachius virens) and three cods (Gadus morhua) at different frequencies as well as angles between the center line of the transducer beams and the fish bodies. The frequencies are 2, 3.5, and 6 MHz. The angles are -30°, -15°, 0°, 15°, and 30°. The results show that even though there are variations, a scan of the ultrasound backscatter along a fish of a specific species contains patterns that are characteristic for that species. This is true at all frequencies in the low MHz range. The part of a fish that contributes most is not necessarily the swimbladder as the results indicate that in the low MHz frequency range bone structures, and skin surfaces are more important.

The second case study was to develop a method to generate simulated ultrasound images from computed tomography images to build simulated ultrasound range profiles of fish. It can be observed from the first case study that shadow effects are normally pronounced in ultrasound images, so they should be included in the simulation. In this study, a method to capture the shadow effects has been developed, which makes the simulated ultrasound images appear more realistic. The method using a focused beam tracing model gives diffuse shadows that are similar to the ones observed in measurements on real objects.

The last case study was to do measurements of ultrasound range profiles of free-swimming fish using a 1 MHz wideband single-element transducer system. The portable system consists of a Reson TC3210 1 MHz single-element transducer, a BlueView P900-2250 dual-frequency multi-beam sonar, and three Oregon ATC9K cameras on a fixture. The positions, orientations, and lengths of the fish were estimated by three-dimensional image analysis, while species were identified manually from the video sequences. Ex-situ experiments were performed on fish that have swimbladder (cod, European sea bass (Dicentrarchus labrax), gilthead sea bream (Sparus aurata), and Atlantic horse mackerel (Trachurus trachurus)) as well as on fish that do not have swimbladder (Atlantic mackerel (Scomber scombrus)). There are indications that the variations in the range profiles seem to have some unique details to discriminate between species like mackerel and sea bream. In some cases the range profiles also indicate whether the head or the tail is closest to the transducer. It has also been shown that the surface areas of the fish are the most important elements that decide how much energy is backscattered in the low MHz frequency range.

In conclusion, the ultrasound backscatter from fish in the MHz frequency range was investigated empirically as well as by simulation and the 1 MHz wideband single-element transducer system was developed. The results data from the ex-situ experiments in a large aquarium tank presented in the last case study can be considered comparable to data obtained in in-situ experiments in a calm shallow sea area. The single-element transducer system can therefore be considered ready for preliminary in-situ experiments. Hereby the main objectives of the Ph.D. study have been reached.
Authors: Pham, A. H. (Intern), Lundgren, B. (Intern), Stage, B. (Intern), Jensen, J. A. (Intern)
Number of pages: 171
Publication date: 2013

**Publication information**

Place of publication: Kgs. Lyngby
Publisher: Technical University of Denmark (DTU)
Original language: English
Main Research Area: Technical/natural sciences
Electronic versions:
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**Relations**

Projects:
In-situ identification of marine organisms using high frequency, wideband ultrasound
Publication: Research › Ph.D. thesis – Annual report year: 2013

Kulturbankeprojekt med udlægning af blåmuslinger produceret på langline

**General information**

State: Published
Organisations: National Institute of Aquatic Resources, Danish Shellfish Centre, Section for Ecosystem based Marine Management, Research Secretariat, Section for Marine Living Resources, DHI Denmark, Danish Shellfish Centre, University of Copenhagen
Authors: Dolmer, P. (Intern), Christensen, H. T. (Intern), Christoffersen, M. O. (Intern), Hansen, F. T. (Ekstern), Mehlenberg, F. (Ekstern), Lisbjerg, D. (Intern), Stage, B. (Intern), Landes, A. (Intern), Nielsen, P. (Intern), Tørring, D. (Ekstern)
Number of pages: 29
Publication date: 2013

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Publication: Commissioned › Report – Annual report year: 2013

Udvikling af effektivt og skånsomt redskab til toblispiskeri på Dogger Banke

**General information**

State: Published
Organisations: National Institute of Aquatic Resources, Section for Marine Ecology and Oceanography, Section for Ecosystem based Marine Management, Section for Marine Living Resources
Authors: Behrens, J. (Intern), Dinesen, G. E. (Intern), Tørring, P. (Ekstern), Eigaard, O. R. (Intern), Pedersen, E. M. (Intern), Stage, B. (Intern), Sørensen, T. K. (Intern), Mosegaard, H. (Intern)
Publication date: 2013
Event: Abstract from 17. Danske havforskermøde, Roskilde, Denmark.
Main Research Area: Technical/natural sciences
Publication: Research › Conference abstract for conference – Annual report year: 2013

Fully Documented Fishery onboard gillnet vessels >15 m

**General information**

State: Published
Observing incidental harbour porpoise Phocoena phocoena bycatch by remote electronic monitoring

Quantification of marine mammal bycatch is important in relation to conservation and management of protected species. Hitherto, using onboard observers has been the most reliable and accurate method but observer programs can be prohibitively expensive. To investigate the potential of CCTV cameras to document bycatch of marine mammals, 6 Danish commercial gillnetters (10 to 15 m in length) operating under the Danish catch quota management system were equipped with Remote Electronic Monitoring (REM) systems. The REM systems provided video footage, time and position of all net hauls and bycatches of marine mammals. Comparisons between REM results and fishers logbooks showed that the REM system gave more reliable results, since fishers in many cases did not observe the bycatch while working on the deck because the bycatch dropped out of the net before coming on board. Furthermore, very high coverage percentages at low cost, compared to onboard observers, could be obtained with REM. Alternative means of conducting the video analysis were tested; they were however, found not to be very efficient.

General information
State: Published
Publication information
Organisations: National Institute of Aquatic Resources, Section for Coastal Ecology, Section for Public Sector Consultancy, Section for Population Ecology and Genetics
Authors: Kindt-Larsen, L. (Intern), Dalskov, J. (Intern), Stage, B. (Intern), Larsen, F. (Intern)
Number of pages: 75-83
Publication date: 2012
Main Research Area: Technical/natural sciences
Journal: Endangered Species Research
Volume: 19
ISSN (Print): 1863-5407
Ratings:
Web of Science (2018): Indexed yes
Scopus rating (2017): CiteScore 2.55 SJR 1.188 SNIP 1.115
Web of Science (2017): Indexed Yes
Scopus rating (2016): CiteScore 1.95 SJR 0.906 SNIP 0.839
Web of Science (2016): Indexed yes
Scopus rating (2015): SJR 0.955 SNIP 0.857 CiteScore 1.83
Web of Science (2015): Indexed yes
Scopus rating (2014): SJR 1.166 SNIP 1.293 CiteScore 2.24
Scopus rating (2013): SJR 1.346 SNIP 1.173 CiteScore 2.49
ISI indexed (2013): ISI indexed no
Web of Science (2013): Indexed yes
Scopus rating (2012): SJR 1.161 SNIP 1.11 CiteScore 2.26
ISI indexed (2012): ISI indexed no
Web of Science (2012): Indexed yes
Scopus rating (2011): SJR 1.563 SNIP 1.296 CiteScore 2.46
ISI indexed (2011): ISI indexed no
Scopus rating (2010): SJR 1.159 SNIP 0.989
Optimization of fisheries resource exploitation in the Skagerrak (Oskar)

General information
State: Published
Organisations: Section for Population Ecology and Genetics, National Institute of Aquatic Resources, Section for Monitoring, Section for Management Systems, Department of Informatics and Mathematical Modeling, DTU Data Analysis, Section for Ocean Ecology and Climate
Publication date: 2012

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Place of publication: Charlottenlund
Publisher: DTU Aqua, Institut for Akvatiske Ressourcer
ISBN (Print): 978-87-7481-138-1
Original language: English
Series: DTU Aqua Report
Number: 239-2011
ISSN: 1395-8216
Main Research Area: Technical/natural sciences

Shadow effects in simulated ultrasound images derived from computed tomography images using a focused beam tracing model
Simulation of ultrasound images based on computed tomography (CT) data has previously been performed with different approaches. Shadow effects are normally pronounced in ultrasound images, so they should be included in the simulation. In this study, a method to capture the shadow effects has been developed, which makes the simulated ultrasound images appear more realistic.
The method using a focused beam tracing model gives diffuse shadows that are similar to the ones observed in measurements on real objects. Ultrasound images of a cod (Gadus morhua) were obtained with a BK Medical 2202 ProFocus ultrasound scanner (BK Medical, Herlev, Denmark) equipped with a dedicated research interface giving access to beamformed radio frequency data.
CT images were obtained with an Aquilion ONE Toshiba CT scanner (Toshiba Medical Systems Corp., Tochigi, Japan). CT data were mapped from Hounsfield units to backscatter strength, attenuation coefficients, and characteristic acoustic impedance. The focused beam tracing model was used to create maps of the transmission coefficient and scattering strength maps. FIELD II was then used to simulate an ultrasound image of 38.955.34.5 mm, using 106 point scatterers. As there is no quantitative method to assess quality of a simulated ultrasound image compared to a measured one, visual inspection was used for evaluation.
Ultrasound backscatter from free-swimming fish at 1 MHz for fish identification

In the frequency range well below 1 MHz, the swimbladder is often considered the most important part for acoustic fish detection. In this work a portable system was developed to not only detect but also try to identify free-swimming fish. It has been used to measure the ultrasound backscatter at 1 MHz from fish.

The system consists of a Reson TC3210 1 MHz single-element transducer, a dual-frequency, multi-beam Blueview P900-2250 sonar, and three Oregon ATC9K cameras. The Reson transducer is connected to an Olympus pulser-receiver monitored by a portable computer through a Picoscope 4226 PC oscilloscope. Exsitu experiments were performed at the NorthSea Oceanarium in Hirtshals, Denmark. The positions, orientations, and lengths of fish were estimated by three dimensional image analysis, taking the measured acoustic distance into account, while species were identified manually. These experiments indicate that at 1 MHz the surface areas (also fins and tail) of the fish can give echoes that are much stronger (up to 3 times) than the swimbladder can, therefore important for identification of fish.
Design of integrated survey systems to provide high quality, low-cost data for marine management.

**General information**
- **State:** Published
- **Organisations:** Section for Vessels, National Institute of Aquatic Resources, Section for Management Systems
- **Authors:** Stage, B. (Intern), Lundgren, B. (Intern), Lisbjerg, D. (Intern)
- **Publication date:** 2011
- **Event:** Poster session presented at 16. Dansk Havforskermøde, Knebel, Denmark.
- **Main Research Area:** Technical/natural sciences
- **Source:** orbit
- **Source-ID:** 274923
- **Publication:** Research › Poster – Annual report year: 2011

High-resolution geo-coded mapping of shallow-water benthic ecosystems using a towed video-array: A pilot experiment

**General information**
- **State:** Published
- **Organisations:** Section for Vessels, National Institute of Aquatic Resources, Section for Management Systems, Section for Population Ecology and Genetics
- **Authors:** Stage, B. (Intern), Lundgren, B. (Intern), Pedersen, E. M. (Intern), Lisbjerg, D. (Intern)
- **Publication date:** 2011
- **Event:** Poster session presented at 16. Dansk Havforskermøde, Knebel, Denmark.
- **Main Research Area:** Technical/natural sciences
- **Source:** orbit
- **Source-ID:** 274922
- **Publication:** Research › Poster – Annual report year: 2011

Simulation of shadowing effects in ultrasound imaging from computed tomography images

**General information**
- **State:** Published
- **Organisations:** Section for Management Systems, National Institute of Aquatic Resources, Section for Vessels, Biomedical Engineering, Department of Electrical Engineering
- **Authors:** Pham, A. H. (Intern), Stage, B. (Intern), Hemmsen, M. C. (Intern), Lundgren, B. (Intern), Pedersen, M. M. (Intern), Jensen, J. A. (Intern)
- **Pages:** 1411-1414
- **Publication date:** 2011

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- **Title of host publication:** Proceedings of IEEE International Ultrasonics Symposium Proceedings
- **ISBN (Print):** 978-1-4577-1251-7
- **Main Research Area:** Technical/natural sciences
- **Conference:** 2011 IEEE International Ultrasonics Symposium, Orlando, FL, United States, 18/10/2011 - 18/10/2011
- **DOIs:**
  - 10.1109/ULTSYM.2011.0349

**Bibliographical note**
- **Art. no.:** 6293054
- **Source:** orbit
- **Source-ID:** 286609
- **Publication:** Research › Article in proceedings – Annual report year: 2011

Simulation of ultrasound backscatter images from fish

The objective of this work is to investigate ultrasound (US) backscatter in the MHz range from fish to develop a realistic and reliable simulation model. The long-term objective of the work is to develop the needed signal processing for fish species differentiation using US. In in-vitro experiments, a cod (Gadus morhua) was scanned with both a BK Medical ProFocus 2202 ultrasound scanner and a Toshiba Aquilion ONE computed tomography (CT) scanner. The US images of the fish were compared with US images created using the ultrasound simulation program Field II. The center frequency of the transducer is 10 MHz and the Full Width at Half Maximum (FWHM) at the focus point is 0.54 mm in the lateral direction. The transducer model in Field II was calibrated using a wire phantom to validate the simulated point spread function. The inputs to the simulation were the CT image data of the fish converted to simulated scatter maps. The positions of the point scatterers were assumed to be uniformly distributed. The scatter amplitudes were generated with a new method based on
the segmented CT data in Hounsfield Units and backscatter data for the different types of tissues from the literature. The simulated US images reproduce most of the important characteristics of the measured US image.

General information
State: Published
Organisations: Section for Management Systems, National Institute of Aquatic Resources, Section for Vessels, Biomedical Engineering, Department of Electrical Engineering, Center for Fast Ultrasound Imaging
Authors: Pham, A. H. (Intern), Stage, B. (Intern), Hemmsen, M. C. (Intern), Lundgren, B. (Intern), Pedersen, M. M. (Intern), Pedersen, T. B. (Ekstern), Jensen, J. A. (Intern)
Number of pages: 10
Pages: Article Number: 796152
Publication date: 2011

Host publication information
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Publisher: SPIE - International Society for Optical Engineering
ISBN (Print): 978-0-8194-8503-8
Series: Proceedings of SPIE - International Society for Optical Engineering
Volume: 7961
ISSN: 0277-786X
Main Research Area: Technical/natural sciences
Ultrasound, Simulation, Acoustical properties, Small animal experiment, CT
Electronic versions:
SPIE2011_pham_et_al.pdf
DOIs:
10.1117/12.878012
Source: orbit
Source-ID: 275604
Publication: Research - peer-review › Article in proceedings – Annual report year: 2011

Habitat mapping as part of an ecosystem-based approach to management of coastal waters

General information
State: Published
Organisations: Research Secretariat, National Institute of Aquatic Resources, Section for Fisheries- and Monitoring Technology
Authors: Lisbjerg, D. (Intern), Pham, A. H. (Intern), Stæhr, K. (Intern), Stage, B. (Intern), Lundgren, B. (Intern)
Publication date: 2009
Main Research Area: Technical/natural sciences
Source: orbit
Source-ID: 253074
Publication: Research › Poster – Annual report year: 2009

cVessel-noise measurements of the fisheries research vessel Dana: a simplified cost-effective method

General information
State: Published
Organisations: Section for Fisheries- and Monitoring Technology, National Institute of Aquatic Resources
Authors: Stæhr, K. (Intern), Stage, B. (Intern), Lundgren, B. (Intern)
Pages: 141
Publication date: 2008
Main Research Area: Technical/natural sciences

Publication information
Journal: Bioacoustics
Volume: 17
ISSN (Print): 0952-4622
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BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
Observed reactions of fish in captivity to replayed vessel-noise sounds from the fisheries research vessel Dana

General information
State: Published
Organisations: Section for Fisheries- and Monitoring Technology, National Institute of Aquatic Resources, Section for Management Systems
Authors: Stage, B. (Intern), Stæhr, K. (Intern), Nielsen, J. R. (Intern), Lundgren, B. (Intern)
Pages: 217-219
Publication date: 2008
Main Research Area: Technical/natural sciences

Publication information
Journal: Bioacoustics
Volume: 17
ISSN (Print): 0952-4622
Ratings:
BFI (2018): BFI-level 1
Sidescan Sonar Image Matching Using Cross Correlation

When surveying an area for sea mines with a sidescan sonar, the ability to find the same object in two different sonar images is helpful to determine the nature of the object. The main problem with matching two sidescan sonar images is that a scene changes appearance when viewed from different viewpoints. This paper presents a novel approach for matching two sidescan sonar images. The method first registers the two images to ground, then uses the cross correlation of the object positions on the seabed to find the correct displacement between the two images. In order to correct any minor displacements of the relative objects position as a result of the ground registration, the object position is given an area of influence. The method is compared to an existing method for matching sidescan sonar images based on hypothetical reasoning. The two methods are compared on a number of real sidescan sonar images in which the displacement is already known, as well as on images taken of a scene from two different viewpoints. We conclude that the proposed method has fewer variables to tune in order to get satisfactory results, and that it gives better or equal results compared to the hypothetical reasoning method.

General information
State: Published
Organisations: Department of Electrical Engineering, National Institute of Aquatic Resources, Danish Defence Research Establishment
Deconvolution of In Vivo Ultrasound B-Mode Images

An algorithm for deconvolution of medical ultrasound images is presented. The procedure involves estimation of the basic one-dimensional ultrasound pulse, determining the ratio of the covariance of the noise to the covariance of the reflection signal, and finally deconvolution of the rf signal from the transducer. Using pulse and covariance estimators makes the approach self-calibrating, as all parameters for the procedure are estimated from the patient under investigation. An example of use on a clinical, in-vivo image is given. A 2 × 2 cm region of the portal vein in a liver is deconvolved. An increase in axial resolution by a factor of 2.4 is obtained. The procedure can also be applied to whole images, when it is ensured that the rf signal is properly measured. A method for doing that is outlined.

General Information

State: Published
Organisations: Biomedical Engineering, Department of Electrical Engineering, Section for Vessels, National Institute of Aquatic Resources, Technical University of Denmark
Authors: Jensen, J. A. (Intern), Stage, B. (Intern), Mathorne, J. (Ekstern), Gravesen, T. (Ekstern)
Pages: 122-133
Publication date: 1993
Main Research Area: Technical/natural sciences

Publication Information

Journal: Ultrasonic Imaging
Volume: 15
Issue number: 2
ISSN (Print): 0161-7346
Ratings:
BFI (2018): BFI-level 1
Web of Science (2018): Indexed yes
BFI (2017): BFI-level 1
Scopus rating (2017): SNIP 0.921 SJR 0.692 CiteScore 2.06
Web of Science (2017): Indexed yes
BFI (2016): BFI-level 1
Scopus rating (2016): SJR 0.745 SNIP 0.906 CiteScore 1.75
BFI (2015): BFI-level 1
Scopus rating (2015): SJR 0.61 SNIP 0.736 CiteScore 1.76
BFI (2014): BFI-level 1
Scopus rating (2014): SJR 0.915 SNIP 0.996 CiteScore 1.63
BFI (2013): BFI-level 1
Scopus rating (2013): SJR 0.785 SNIP 0.621 CiteScore 1.29
ISI indexed (2013): ISI indexed yes
Web of Science (2013): Indexed yes
BFI (2012): BFI-level 1
Projects:

**Ballast water - Tool for supporting the delimitation of a "same risk area" (39348)**

A project financed by the Danish Maritime Fund via the Danish Nature Agency, to develop a decision support tool for authorities and consultants involved with the ballast water convention and measures preventing the spread of marine invasive species. The tool will support decision makers in member nations of the International Maritime Organisation (IMO) to identify and delimit marine areas with high connectivity considering hydrography and species biology. Identification of marine areas with high connectivity can provide a basis for granting exemptions in relation to the ballast water convention and the requirement for ships to treat ballast water before being discharged into the sea. The tool development is based on existing freeware including "IBM Lib" (DTU Aqua's own individual-based modeling system for linking individual-based models to hydrographical model data), Netlogo (a widely used IBM simulation system) and R (a statistical programming and data handling package).

This project is coordinated by DTU Aqua.

The project is funded by the Danish Maritime Fund via the Danish Nature Agency.

National Institute of Aquatic Resources

Section for Marine Living Resources

Danish Meteorological Institute

Anchor-Lab

Period: 01/03/2016 → 01/12/2016

Number of participants: 9

Research areas: Marine Living Resources & Observation Technology

Project participant:

Mosegaard, Henrik (Intern)

Stage, Bjarne (Intern)
The purpose of the project is to develop a new type of fishing gear, Sound Herding System (SHS), which applies sound to influence fish swimming direction and thereby herding them into a trawl. The sounders are mounted on the trawl boards, so as to create a wall of sound on both sides of the trawl opening. This increases the effective width and height of the trawl opening, resulting in higher catch rates. The frequency of the sounders is selected to be 4 kHz, which can be used to affect the clupeoid species herring, sprat and anchovy. Most other relevant species are not sound sensitive at this frequency.

The system can be used to avoid by-catches of herring in the mackerel fishery by closing trawl opening for herring with sound. Customers receive economic gains from higher catch rates and smaller by catch. The gain for the environment is a reduction in CO2 emissions and improved resource utilization.

The central work in the project is the development of trawl doors equipped with sounders as tested by exploratory scare effect measurements and mapping of sound fields. Fish response to sound is studied experimentally and finally the sounders’ impact on the environment is examined.

This project is coordinated by Sonus Aqua Aps, Denmark.

The project is funded by the Ministry of Environment and Food of Denmark through the Green Development and Demonstration Program (GUDP).

National Institute of Aquatic Resources
Section for Marine Living Resources
Sonus Aqua Aps
Aalborg University
Period: 01/01/2016 → 31/12/2018
Number of participants: 3
Research areas: Observation Technology & Marine Living Resources
Project participant:
Mosegaard, Henrik (Intern)
Pedersen, Eva Maria (Intern)
Project Manager, academic:
Stage, Bjarne (Intern)
Project

The project aims to provide proof of concept for the use of robots in the fishery, focusing on three specific types for three different implementations. One will be used to determine the species and size composition of fish in the catch to prevent discards, the other to search for fish optically with a drone (capelin in Greenland) and the third a sailing robot to search for fish using sonar. The robots/drones to be employed are available on the marked. A development project must subsequently design software etc. to produce marketable products. It is estimated that there is a great potential in Denmark and a huge world market for these technologies that presently are not employed in fishery.

This project is coordinated by DTU Aqua.

The project is funded by the Ministry of Environment and Food of Denmark through the Green Development and Demonstration Program (GUDP).

National Institute of Aquatic Resources
**Underwater time of flight image acquisition system (UTOFIA) (39240)**

This project offers a compact and cost-effective underwater imaging system for turbid environments and will fill the current gap between short-range, high-resolution conventional video and long-range low-resolution sonar systems. The camera system utilizes high frequency laser pulses synchronized with rapid shutter operations on nano second time scales to radically reduce the interference of back scatter on visual images. Using this range-gated imaging technology, the system will extend the imaging range by factor 2 to 3 over conventional video systems. At the same time, the system will provide video-rate 3D information. UTOFIA offers a new modus operandi for the main targeted domains of application: marine life monitoring, harbour and ocean litter detection, fisheries stock assessment and aquaculture, seabed mapping, offshore industry and civil security.

The project is a collaborative effort between engineering companies producing the laser components, the camera systems, the software control and processing systems as well as the deployment platforms. The project also involves companies charged with integrating the system and its commercialization into the market place. The role of DTU Aqua is twofold; it is responsible for a series of field and laboratory trials to demonstrate the proof-of-concept and to feed back into the engineering design process, and it is responsible for the exploitation and dissemination dimension of the project, particularly with respect to marine science, fisheries and aquaculture applications.

The consortium is coordinated by SINTEF, Norway.

The project is funded by EU, Horizon2020.
Dynamic user-driven marine e-maps for the advancement of Danish industrial fisheries (GUPD-VIND) (39246)
This project aims at strengthening Danish industrial fisheries development in order to (i) reduce the search time and fuel consumption per ton of fish caught (revenues: 16 million DKK/year), (ii) make better use of the sprat quota (revenues: 15 million DKK/year, by a full quota uptake), (iii) pave the way for sustainable self-management of resources in the industrial fisheries sector and (iv) contribute to creating and maintaining jobs in the local fishing community.

The specific objectives of the project: Development of an IT tool that will contain (i) a platform to improve sharing of knowledge and registration of observable and derived variables (data), and (ii) user-defined and user-controlled digital Marine Maps with those specific data that fishermen consider important as background information in the planning and implementation of fishing trips. These marine data include (but are not limited to) a portfolio of Marine Maps spanning from the North Sea hydrography and bottom conditions over distribution of plankton and fish to water-DNA.

The needs for a technological development of this fishery comes from increasing average vessel size, while the number of large vessels is reduced to about 1/8 of what it was in the past. The immediate consequence is a reduction in the collective search performance and knowledge sharing. In addition, the area based management of the sandeel fishery introduced in 2011 has contributed to a reduction of fishermen’s opportunities to diversify fishing and explore a wider variety of fishing grounds. Finally, the sprat fishery is uncertain because of by-catch limits and a very variable CPUE driven by wind and weather. This has led to an underutilization of the sprat quota by around 100,000 tons per year. Fishermen knowledge of good fishing opportunities is based on the correspondence between historical catches and observable variables at the time of capture, such as the seasons, wind, waves and tides, and it is precisely this kind of knowledge that the project wants to combine with a technological solution, so that all relevant data is made widely available to the fishermen by developing user-controlled dynamic digital Marine Maps. The project includes a business plan for the IT company Anchor Lab, which develops the user-controlled Marine Maps, and plans for derived effects in terms of better utilization of the sprat quota and fuel savings through the use of the Marine Maps. Besides the economic effects, the project contributes to CO2 reduction, and supports the technological development of a modern industrial fishery sector, based on a natural resource to be managed by the EU in accordance with ICES’ advice.

This project is coordinated by DTU Aqua.

The project is funded by the Ministry of Environment and Food of Denmark through the Green Development and Demonstration Program (GUDP).

National Institute of Aquatic Resources
Section for Marine Living Resources
Danish Meteorological Institute
Anchor-Lab
Period: 01/01/2015 → 30/06/2018
Number of participants: 8
Research areas: Marine Living Resources & Marine Populations and Ecosystem Dynamics & Population Genetics & Observation Technology
Project participant:
Christensen, Asbjørn (Intern)
Stage, Bjarne (Intern)
Eg Nielsen, Einar (Intern)
Worsøe Clausen, Lotte (Intern)
van Deurs, Mikael (Intern)
Andersen, Niels Gerner (Intern)

Project Manager, organisational:

Pedersen, Eva Maria (Intern)
Project Coordinator:
Mosegaard, Henrik (Intern)

New methods and models for population estimates of mussels with the use of GPS data (39088)
Based on the new management requirements from authorities and industry, the access to new data collection and the desire for more mussel fishing areas, there is a need for the development of new tools for monitoring and managing shellfish stocks.

The aim of the project was to develop new methods and models for estimating shellfish stocks in Denmark that may include several types of information to the management. The project worked with stratified extensive sampling strategies such as sidescan sonar, video recordings, data from automated GPS loggers from industry’s own data and classical
biomass collection.

Based on the data collected different types modeling tools was developed. The project has resulted in a new management tools for population estimation with different degrees of detail and types of information.

This project was coordinated by DTU Aqua.

The project was funded by the Danish Ministry of Food, Agriculture and Fisheries and the European Fisheries Fund (EFF).

National Institute of Aquatic Resources

Danish Shellfish Centre

Orbicon

Foreningen Muslingeerhvervet
Period: 01/01/2014 → 30/06/2015
Number of participants: 8
Research areas: Coastal Ecology & Observation Technology & Marine Living Resources
Project participant:
Canal-Vergés, Paula (Intern)
Saurel, Camille (Intern)
Thygesen, Uffe Høgsbro (Intern)
Stage, Bjame (Intern)
Kristensen, Kasper (Intern)
Geitner, Kerstin (Intern)
Project Coordinator:
Petersen, Jens Kjerulf (Intern)

Ecosystem based method for impact assessment (39142)
The project aimed to develop a methodology for impact assessment and measures to support the implementation of the Marine Strategy Framework and Natura 2000.

The project included
- Development of an approach to impact assessment and step by step guide for management actions to ensure biodiversity, marine food webs and seabed integrity.
- A Case Study on the Dogger Bank to support the implementation of the Natura 2000 processes was evaluated and best practice identified.
- A Case study in the Kattegat with monitoring and ecosystem analysis of muddy habitats to optimize nature conservation and fisheries management under the Marine Strategy was evaluated and best practice identified.
- Development of cost-effective methods for management, monitoring and control in a report that describes the best practices in the subareas and the related costs.

The project was coordinated by DTU Aqua.

The project was funded by the Danish Ministry of Food, Agriculture and Fisheries and the European Fisheries Fund (EFF).

National Institute of Aquatic Resources

Arctic Section

Danish Anglers Association

Dalsgaard Data A/S

Silkeborg Fiskeriforening
Period: 23/07/2013 → 01/05/2015
Number of participants: 4
Research areas: Observation Technology & Marine Living Resources & Coastal Ecology
Project participant:
Pederssen, Eva Maria (Intern)
Mosegaard, Henrik (Intern)
Dinesen, Grete E. (Intern)
Efficient and low impact gear in the Danish fishery for industrial species (GUDP Tobis) (38849)
The aim of the project was to ensure the future of the Danish industrial fisheries in the increasing demands for reduced environmental impact. The Danish industrial fisheries amount to around 800 million DKK a year in first value. The industrial fishing for sandeel, was seen threatened by a potential ban against bottom trawling in the main fishing areas at Dogger Bank in the North Sea, due to appointment of a large Natura 2000 area by UK, the Netherlands and Germany where bottom trawl could be considered to affect the conservation status of the sand habitat negatively. In addition profitability was threatened by the high vessel operating cost, considering fuel prices at the time.

The objective was to develop and document a fishing method for industrial fisheries (sandeel, Norway pout and sprat) where the trawl doors don't have bottom contact and where modern materials are used in the gear and for the wire. Thus, compared to traditional gear, an overall energy saving of minimum 30% on each kg fish caught was expected, and also the damages on the benthic fauna was expected to be reduced or eliminated.

The new pelagic gear was constructed according to specifications. It behaved as intended and could easily be operated on Dogger Bank. The new gear consisting of pelagic doors and Dynema equipped trawl has attracted considerable attention among fishers and can be considered a business success. Catch volumes (tons/hour) did not differ between the experimental and standard trawl under parallel fishing. Sandeel behavioral differences could not be identified from sonar and UV-camera recordings, and size and oil content of sandeels was not systematically different between the two gears.

Calibration experiments demonstrated 24 % lower fuel consumption in the new trawl.

Bottom surveys were carried out annually from 2012 to 2014 in the North-eastern part of Dogger Bank (in the Dutch/NL EEZ) at approximately 35 meters depth. Sediment analyses showed a grain size composition dominated by fine sand mixed with small amounts of gravel, whereas fine particles comprises 1 % maximum ideal as a sandeel habitat. Grain size composition was not altered by trawling or time.

Bottom impact with new gear is estimated to be 30 % reduced compared to a similar trawl using conventional doors. Based on the side-scan sonar recordings it was not possible to distinguish differences between the two trawl types in sediment depth penetration. The foot prints left by both sandeel trawls in one year were not discernible in subsequent years. Results from the video record analyses showed especially conch and hermit crabs were more abundant soon after trawling compared to before impact. The sediment analyses revealed nearly 100 different invertebrate species many of which lives burrowed or tube building in the sand. Overall diversity did not differ significantly between transects trolled by the two gears and the non-trawled transect. Detailed analyses showed, however, that some species (fragile sea anemones, polychaetes and echinoderms) were less abundant after impact from the conventional trawl compared with the newly-designed trawl and the control transect. A few species were more abundant in the transect trolled by the conventional trawl, including some smaller crustaceans. These results suggest the newly-designed sand eel trawl has a lower impact on benthic fauna than the conventional trawl and we expect the final analyses will support these results.

The project is coordinated by DTU Aqua.

The project was funded by the Danish Ministry of Food, Agriculture and Fisheries through the Green Development and
Demonstration Program (GUDP).
National Institute of Aquatic Resources
Section for Marine Living Resources
Thyborøn Harbours Fishermen’s Association
Northsea Trawl
Thyborøn Trawldoor.dk
Period: 01/01/2012 → 05/01/2015
Number of participants: 6
Research areas: Marine Living Resources & Fisheries Management & Observation Technology
Project participant:
Eigaard, Ole Ritzau (Intern)
Dinesen, Grete E. (Intern)
Stage, Bjarne (Intern)
Madsen, Niels (Intern)
Project Manager, organisational:
Pedersen, Eva Maria (Intern)
Project Coordinator:
Mosegaard, Henrik (Intern)

Optimal sustainable exploitation of Nephrops norvegicus in Kattegat and Skagerrak (38909)
The scientific advice on management of fisheries is primarily aiming at avoiding overfishing of the fish and shellfish stocks and only to a very limited extend addresses how the utilisation of the resources can be optimised within a sustainable ecosystem framework. An example is the regulation of the demersal trawl fisheries in the Skagerrak and the Kattegat which to protect the cod stock is sub-optimal in relation to the utilisation of the Norway lobster (Nephrops) stocks. The project takes a new approach to the management and aims at optimising the utilisation of Nephrops stocks without compromising the protection of cod.

The Nephrops fishery is one of the economically most important fisheries in Denmark. In the Kattegat and Skagerrak, Nephrops catches accounted in 2010 for 53 % and 25 % of the total value of fish and shellfish, respectively, landed by Danish fishermen. Cod is taken as by-catch in the Nephrops fishery and it has been necessary to introduce measures to limit the by-catches of cod, which is currently below agreed reference points for stock size. These measures have had a negative impact on Nephrops catches.

The project addressed four objectives: (i) development of advice on the fishing mortality for the Nephrops stocks, which is consistent with maximum sustainable yield; (ii) mapping of the distribution of Nephrops in Skagerrak and Kattegat; (iii) development of a new trawl concept optimising the catchability on Nephrops while limiting the by-catches of cod and impact on the sea bed; and (iv) evaluating alternative fishing methods for Nephrops including fishing with pots.

The project was coordinated by DTU Aqua.

The project was funded by the Danish Ministry of Food, Agriculture and Fisheries through the Green Development and Demonstration Program (GUDP).

National Institute of Aquatic Resources
Section for Ecosystem based Marine Management
Danish Fishermen's Association
Period: 01/01/2011 → 31/12/2014
Number of participants: 10
Research areas: Fisheries Management & Fisheries Technology & Marine Living Resources
Project participant:
Nielsen, Anders (Intern)
Madsen, Niels (Intern)
Krag, Ludvig Ahm (Intern)
Eigaard, Ole Ritzau (Intern)
Stage, Bjarne (Intern)
Project Manager, academic:
Kirkegaard, Eskild (Intern)
Management of fisheries in harbour porpoise (Phocoena phocoena) marina protected areas

National Institute of Aquatic Resources
Period: 01/05/2010 → 02/09/2015
Number of participants: 7
Phd Student:
Kindt-Larsen, Lotte (Intern)
Supervisor:
Northridge, Simon (Ekstern)
Stage, Bjarne (Intern)
Main Supervisor:
Larsen, Finn (Intern)
Examiner:
Madsen, Niels (Intern)
Macleod, Kelly (Ekstern)
Read, Andrew Justin (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: 1/3 FUU, 1/3 inst 1/3 Andet
Project: PhD

Fisheries management in NATURE 2000 areas (38797)
Approximately 17% of the Danish sea territory is appointed as Nature 2000 areas. Many of these areas are also very important for fishery. To allow fishery to continue in Nature 2000 sites, it must be demonstrated that the fishery does not negatively impact the basis for appointment for the site. The project aims to establish the science base for development of a concept for Environmental Impact Assessments (EIA) for fishery and aquaculture in Nature 2000 areas, as well as establish interactions between the mussel fishery and the basis for appointment of Nature 2000 areas. The results generated will provide input to the EIA conducted by DTU Aqua and to other advisory issues related to mussel fishery, and to improve the environment in Nature 2000 areas. The approach is a combination of field experiments, model development and theoretical work. Through the project, knowledge will be generated on eelgrass, macrophyte and blue mussel ecology and abundance and interactions with mussel fishery. Development of the oyster fishery in the Wadden Sea will be developed with focus on the Nature 2000 site N89. Seabed mapping of the stone reefs in the Little Belt Sea will include an analysis of the impact of blue mussel fishery on these habitats. Finally the project will establish knowledge base for interactions between aquaculture and Nature 2000 areas.

The project is coordinated by DTU Aqua.

National Institute of Aquatic Resources
Section for Ecosystem based Marine Management
Danish Shellfish Centre
Period: 01/01/2010 → 30/09/2012
Number of participants: 7
Research areas: Ecosystem Based Marine Management & Observation Technology
Project participant:
Dinesen, Grete E. (Intern)
Stage, Bjarne (Intern)
Lisbjerg, Dennis (Intern)
Rasmussen, Richard Skett (Intern)
Project Manager, academic:
Dolmer, Per (Intern)
Christoffersen, Mads (Intern)
Geographical distribution of fish resources and optimizing of fishery practice in the north-eastern North Sea (RESOURCE) (38878)

RESOURCE is a collaborative fishermen-scientist project in direct continuation of the REX projects in the north-eastern North Sea conducting small-scale scientific surveys, but only with one commercial trawler, encompassing also geographical distributional aspects as in OSKAR.

The REX project showed that changes in the biomass densities of cod differ between bottom types (and may depend on stock size) and the proportion of the cod population found on smooth bottoms is not constant. However, due to scaling problems and too short a time series the achieved results have so far had no impact on the assessment procedure or any (measurable) effect on the TAC’s (but the RAC discussions may have affected decisions by the European Commission). Continuation of the field work with the trawler in 2010-12 in the RESOURCE project should produce a sufficient time series for supplementing the abundance indices for the older ages in the assessment, which at present are based only on the catch rates in the international scientific surveys (IBTS). This total REX-RESOURCE time series will be used in the state space assessment of North Sea cod (SAM) and various other approaches applied to document how commercial CPUE may be used in the tuning procedure. Particular attention will be given to evaluate the size of the spawning stock of cod.

Mechanistic knowledge on vital rates together with REX, RESOURCE, OSKAR and IBTS (and possibly also UK) survey data will be used as input to the geostatistical tool GeoPop to estimate the temporal and spatial dynamics of the size distribution of the cod stock. This part of the project will represent a direct continuation of OSKAR principles including considerations to how to design an operational fishery-forecast system for North Sea cod.

The project is coordinated by DTU Aqua.

National Institute of Aquatic Resources
Section for Marine Ecology and Oceanography
Danish Fishermen’s Association
Period: 01/01/2010 → 30/09/2012
Number of participants: 13
Research area: Marine Populations and Ecosystem Dynamics
Project participant:
Andersen, Niels Gerner (Intern)
Pedersen, Eva Maria (Intern)
Andersen, Bo Selgaard (Intern)
Hüssy, Karin (Intern)
Kristensen, Kasper (Intern)
Nielsen, Anders (Intern)
Stage, Bjarne (Intern)
Mosegaard, Henrik (Intern)
Christensen, Asbjørn (Intern)
Mariani, Patrizio (Intern)
Madsen, Niels (Intern)
Project Manager, academic:
Beyer, Jan (Intern)
Wieland, Kai (Intern)

In situ identification of marine organisms using High Frequency, wideband Ultrasound

National Institute of Aquatic Resources
Period: 15/06/2009 → 06/02/2013
Number of participants: 7
Phd Student:
Pham, An Hoai (Intern)
Supervisor:
Jensen, Jørgen Arendt (Intern)
Lundgren, Bo (Intern)
**Evaluation of harbour porpoise behaviour in relation to acoustic alarms (pingers) (38670)**

The project included four sub-projects that were all related to development of methods for mitigation of harbour porpoise by-catch. The first sub-project investigated the effective deterrent range for a commercial pinger and whether the range changed over time (habituation). This is important to know in order to be able to evaluate the effects if pingers are to be used in marine protected areas like the Natura 2000 areas. By deploying automated porpoise click loggers (C-PODs) in a grid around an active pinger, the effective range of the pinger was assessed. The set-up was deployed both in Denmark and in Scotland to also investigate possible regional differences in porpoise reactions to pingers. The second sub-project tested the alerting-hypothesis, i.e. whether it was possible to induce porpoises in the wild to use their biosonar against a target by having the target emit artificial porpoise click trains (alerting signals). Alerting signals have a number of advantages over traditional pinger signals, including that they will not lead to exclusion of porpoises from important habitats, that the risk of habituation is smaller because the porpoises will be able to learn from their experience with the alerting pingers, and that noise pollution will be considerably smaller because the sound level of alerting pingers is much lower than for traditional pingers. The third sub-project tested if pingers emitting alerting-signals could reduce by-catch of harbour porpoises in the commercial gillnet fishery. Alerting pingers were deployed on bottom-set gillnets in a fishery with a high by-catch rates, in a double-blind experiment. The fourth sub-project investigated the behaviour of free ranging harbour porpoises in relation to a gillnet. This included land-based tracking by theodolite of porpoises approaching a bottom-set gillnet to determine detection distances and avoidance behaviour.

The project was coordinated by DTU Aqua.

The project was funded by the Danish Ministry of Food, Agriculture and Fisheries and the European Fisheries Fund (EFF).

National Institute of Aquatic Resources
Section for Ecosystem based Marine Management

**Ultrasound flow imaging using coded signals**

Department of Electrical Engineering
Period: 01/07/2002 → 23/12/2005
Number of participants: 5
Phd Student:
Gran, Fredrik (Intern)
Main Supervisor:
Jensen, Jørgen Arendt (Intern)
Examiner:
Design and Implementation of Algorithms for Improving Synthetic Aperture Ultrasound Images

Department of Electrical Engineering
Period: 01/09/2001 → 21/12/2004
Number of participants: 6
Phd Student:
Gammelmark, Kim (Intern)
Supervisor:
Dall, Jørgen (Intern)
Main Supervisor:
Jensen, Jørgen Arendt (Intern)
Examiner:
Sørensen, Helge Bjarup Dissing (Intern)
Stage, Bjarne (Intern)
Stepinski, Tadeusz (Ekstern)

Financing sources
Source: Internal funding (public)
Name of research programme: Forskningsrådsfinansiering
Project: PhD

Relations
Publications:
Improving the Image Quality of Synthetic Transmit Aperture Ultrasound Images - Achieving Real-Time In-Vivo Imaging
Project: PhD