11:45

3aAO15. Travel time difference and incoherent intensity tomography of the current and turbulence structures of shallow oceans. Tokuo J. Yamamoto (Flosonic Corp., 12200 SW 89th Ave., Miami, FL 33176, tyamamoto@bellsouth.net), Arata Kaneko, and Haruhiko Yamaoka (Hiroshima Univ., Hiroshima, Japan)

Acoustic waves propagating through irrotational current cause a travel time difference between the reciprocal transmission paths. When they propagate through turbulence, they are scattered and a part of the propagating acoustic wave energy becomes incoherent. The two acoustical principles lead to the two corresponding acoustic tomography methods for imaging current and turbulence. The acoustic cross-array tomography (ACT) experiment was conducted at the Kammon Strait on 17–20 March 2003. Eight ACT measurement units were distributed on both sides of the strait. Gold codes having a carrier frequency of 5.5 kHz were transmitted as source signals. The data obtained from the experiment were used in the travel time difference tomography for imaging the current field and in the incoherent acoustic intensity tomography for imaging turbulence in the strait water. The comparisons between the current fields and the turbulence fields reveal that the turbulence intensity is nearly proportional to the current strength. This indicates that the turbulence in the very shallow (roughly 11 m deep) strait water is generated within and may be transported outside the bottom boundary layer. [Work supported by ONR.]

12:00

3aAO16. Acoustic-oceanographic buoy—An easily deployable, reconfigurable, and multifunctional acoustic-oceanographic system. Sergio M. Jesus, Cristiano Soares, Antonio Silva (SiPLAB-FCT, Univ. of Algarve, PT-8005-139 Faro, Portugal), Jean-Pierre Hermand (Université Libre de Bruxelles, 1050 Brussels, Belgium), and Emanuel F. Coelho (NATO Undersea Res. Ctr., I-19138 La Spezia, Italy)

The concept of an easy to use and easy to deploy ocean acoustic tomographic (OAT) system is presented. The system is composed of a network of buoys and a data inversion online processor. This study concerns the individual node of that network—the acoustic-oceanographic buoy (AOB)—the data inversion technique and the testing of the system at sea. The AOB is a lightweight surface buoy with a vertical array of acoustic and temperature sensors to be hand deployed in a free-drifting configuration from a small boat. The data are locally stored and transmitted online to a remote station for processing and monitoring. Data inversion is based on a broadband matched-field tomography technique where known and unknown parameters are simultaneously searched for (focalization). *In situ* recorded temperature data serve for algorithm initialization and calibration. The AOB was successfully deployed in several consecutive days during two rapid environmental assessment sea trials in 2003 (Mediterranean) and 2004 (Atlantic). Data collected at sea also show that the AOB can be reconfigured as a receiving array for underwater coherent communications in the band up to 15 kHz. [Work supported by FCT and Royal Netherlands Navy—Projects NUACE, POSI/CPS/47824/2002 and REA, RNLNC/2003/04.]

WEDNESDAY MORNING, 17 NOVEMBER 2004 PACIFIC SALONS 6 & 7, 8:00 TO 10:30 A.M.

Session 3aBB

Biomedical Ultrasound/Bioresponse to Vibration: Acoustic Bioeffects

Yuri A. Pishchalnikov, Chair

Department of Anatomy and Cell Biology, Indiana University, 635 Barnhill Drive, Indianapolis Indiana 46202-5126

Contributed Papers

8:00

3aBB1. Ultrasonic tissue characterization of the beating hearts of mice: Evidence of anisotropy and of hypertrophy. James G. Miller, Attila Kovacs, Stephanie H. Posdamer, Kirk D. Wallace, Michael R. Courtois, Carla J. Weinheimer, and Mark R. Holland (Dept. of Phys. and Ctr. for Cardiovascular Res., Washington Univ.)

New insights into the disease-altered properties of the heart may be provided through the study of genetically manipulated mice. To extend methods developed for studies of the hearts of patients to the hearts of mice, we report the observation of anisotropy of backscattered ultrasound in the parasternal short-axis view of normal mouse hearts, the cyclic variation of backscatter in normal hearts, and alterations of that pattern of cyclic variation in hypertrophic hearts. Echocardiographic images were obtained using a clinical imaging system with a nominal 13-MHz linear array. In seven wild-type mice the anisotropy of mid-myocardial apparent backscatter arising from the angle of insonification relative to the local fiber orientation in the short-axis view was consistent with that observed previously in the hearts of healthy human volunteers. The magnitude of the cyclic variation of backscatter from the hypertrophic hearts of nine mice subjected to neonatal aortic banding was significantly less than that obtained from eight control, sham-operated mice. This study lays the groundwork for subsequent investigations in which genetically manipulated mice will be measured in order to clarify the mechanisms of altered ultrasonic scattering and attenuation of the disease-altered myocardium in the presence of myocardial anisotropy. [Work supported by NIH R37HL40302.]

8:15

3aBB2. Respiratory smooth muscle relaxation using vibrations. Youhua Du and Ahmed Al-Jumaily (Auckland Univ. of Technol., Private Bag 92006, Auckland, New Zealand)

Many respiratory disorders (asthma in particular) are associated with the shortening of the smooth muscles within the airway walls. This could be attributed to an allergic response that results in airway constrictions. Physically, the shortening of smooth muscles is caused by cross-bridges (the heads of myosin molecules attached to the actins). Muscle relaxation is normally achieved by special bio-chemically driven medications. This work has demonstrated that muscle relaxation can be achieved by mechanical excitation. The dynamic response of contracted tracheal smooth muscles to vibrations under isometric conditions is investigated. This is achieved using two-dimensional finite element modeling as well as experimental investigation. The main algorithm of the finite element modeling is to determine the variation in the muscles' stiffness caused by external excitation. However, the experimentation focused on using an electric field to stimulate the contraction and using mechanical vibration to produce the relaxation. The main outcome from this work is that smooth muscle relaxation can be achieved by contact mechanical vibration. The question that remains to be answered is can contracted smooth muscles be relaxed by noncontact oscillation? Answering this will definitely add to the body of knowledge for developing a drug-free methodology of relieving airway constrictions.