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Session 3aSP

Signal Processing in Acoustics, Engineering Acoustics, and Underwater Acoustics: Acoustic Array Systems and Signal Processing II

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Chair's Introduction—8:30

Contributed Papers

8:35

3aSP1. Recording of extended sound fields using spherical microphone arrays and a-priori knowledge of the sound source positions. Jorge A. Trevino Lopez (Res. Inst. of Elec. Commun. and Graduate School of Information Sci., Tohoku Univ., 2-1-1 Katahira, Aoba-ku, Sendai, Miyagi 9808577, Japan, jorge@ais.riec.tohoku.ac.jp), Keigo Wakayama (NTT Media Intelligence Labs., NTT Corp., Musashino, Tokyo, Japan), Shuichi Sakamoto, Yo-iti Suzuki (Res. Inst. of Elec. Commun. and Graduate School of Information Sci., Tohoku Univ., Sendai, Miyagi, Japan), Hideaki Takada, and Manabu Okamoto (NTT Media Intelligence Labs., NTT Corp., Musashino, Tokyo, Japan)

The acquisition of comprehensive sound field information is a central topic in spatial acoustics. In conventional systems, recording devices must be located at the listener's viewpoint. This research introduces a sound field recording technique for spherical microphone arrays which makes use of *a-priori* information regarding the distribution of sound sources. The proposal generates sound field descriptions for viewpoints that are located away from the recording device, as long as there are no sound sources between the target viewpoint and the microphone array. Sound field descriptions, a set of spherical harmonic expansion coefficients, are generated from the array signals. A translation operator, calculated from approximate source positions known in advance, is defined so as to shift the plane wave decomposition of the partial fields associated with each expansion coefficient. The proposed method is compared with an existing technique based on a different kind of translation operator traditionally used in implementations of the boundary element method. These operators require no a-priori information, but their region of validity is limited by the spherical harmonic expansion order. The conventional method achieves greater accuracy in the proximity of the recording array; however, the proposed method can generate sound field descriptions covering a much larger region.

8:50

3aSP2. Maximum likelihood estimation to denoising channels in beamforming circular array. Fabricio A. Bozzi, José Manoel de Seixas (Sonar Group, Brazilian Navy Res. Inst., Rua Hugo Leal, Rio de Janeiro 21931250, Brazil, bozzi@ipqm.mar.mil.br), Thiago C. Xavier (LabSonar, Federal Univ. of Rio de Janeiro, Rio de Janeiro, Brazil), and Leonardo M. Barreira (Sonar Group, Brazilian Navy Res. Inst., Rio de Janeiro, Brazil)

The delay and sum beamforming is the most simple technique in direction of arrival (DOA) Estimation. Although its performance on spatial discrimination is poor, compared to other beamforming, delay and sum still is used in large operating sound navigation and ranging (SONAR) because of its low computational cost. A circular hydrophone array (CHA), commonly used in SONAR system, is an attractive alternative to provide a more uniform directive response over all azimuth angle. This array is analyzed here, working with experimental data, acquired in a acoustic tank and in the sea. Maximum likelihood estimation (MLE) is applied to denoising noisy channels, summing up them after in delay-and-sum. First of all, a noise in an acoustic tank is considered to represent the hydrophones, cables, and acquisition system noises. Then, an environmental noise is collected in the sea. The MLE use both of them to calculate the weights in the beamforming. A boat is used to running around the array, and the DOA of the uniformly weight and MLE in delay-and-sum shows the performance improvement.

9:05

3aSP3. Simultaneous tracking and counting of targets in a sensor network. Pritthi Chattopadhyay, Asok Ray (Mech. Eng., The Penn State Univ., University Park, PA), and Thyagaraju Damarla (Army Res. Lab., Networked Sensing and Fusion Branch, U.S. Army Res. Lab., Adelphi, MD 20783, thyagaraju.damarla.civ@mail.mil)

Unattended ground sensors (UGS) are widely used to monitor human activities, such as pedestrian motion and detection of intruders in a secure region. This paper presents an algorithm for counting and tracking humans moving through a UGS network. Each node of this sensor network is equipped with a geophone (i.e., seismic sensor) and a microphone (i.e., acoustic sensor). The proposed method analyzes the relational dependence among the responses of sensors at various nodes as the targets walk through the network. The energy distribution across the network for different number of targets walking at different distances from the nodes has been analyzed to predict the number and location of targets in the sensor network field. The proposed concept has the advantages of having fast execution time and low memory requirements and is potentially well-suited for real-time implementation on *in-situ* computational platforms. Keywords—Personnel detection, seismic sensing, acoustic sensing, sensor-network-based fusion.

9:20

3aSP4. Experimental research on acoustic array sonde in borehole azimuthal reflection logging tool. Xiaolong Hao, Xiaodong Ju, Xiling Wu, Junqiang Lu, Baiyong Men, and Zhijun Yu (State Key Lab. of Petroleum Resources and Prospecting, China Univ. of Petroleum, China University of Petroleum, No. 18 Fuxue Rd., Changping, Beijing, China, haoxl315024@163.com)

Phased combined arc array technology was adopted when designing acoustic sonde to enhance 3D detection capability and resolution in borehole azimuthal reflection logging tool. After constructing experimental