matched filter) provides a processing gain (matched filter gain), which enhances the symbol energy over noise, thus allowing communications at low input signal-to-noise ratio (SNR). For underwater communications, additional processing is needed to mitigate the effect of the rapid temporal fluctuation of the propagation channel. This paper analyzes DSSS data collected during the TREX04 experiment, which uses an m-sequence as the spreading code. More than 1,000 packets have been analyzed at input SNR, varying from -15 dB to $+23$ dB. Zero-bit errors were achieved for input SNR as low as -8 to -10 dB for two processors used. Performance loss due to inaccurate synchronization, inaccurate channel estimation, and signal fading are quantitatively modeled as a function of decreasing SNR. [Work supported by ONR.]

FRIDAY AFTERNOON, 30 NOVEMBER 2007 GRAND BALLROOM B, 3:00 TO 5:20 P.M.

Session 4pSPb

Signal Processing in Acoustics: Three-Dimensional Arrays, Machine Noise and Vibration

Natalia A. Sidorovskaia, Chair
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Chair's Introduction—3:00

Contributed Papers

3:05

4pSPb1. The analogy between acoustic holography and sound field reproduction. Ji-Ho Chang and Yang-Hann Kim (Ctr. for Noise and Vibration Control, Korea Adv. Inst. of Sci. and Technol., Sci. Town, Daejon 305-701, South Korea)

Acoustic holography is to predict sound field by sound pressure values on measurement plane while sound field reproduction is to generate sound field by loudspeakers. They have absolutely different objectives but handle sound field so that they have a common mathematical approach according to the shape of the sound field of interest. Hence several methods of sound field reproduction, WFS, ambisonics, BPC, mode matching method, etc., correspond with each category of acoustic holography: plane holography, cylindrical holography and spherical holography, etc. In this paper, mathematical and technical similarities are introduced and discussed. [This work was supported by the Korea Science and Engineering Foundation (KOSEF) through the National Research Lab. Program funded by the Ministry of Science and Technology (M10500000112-05J0000-11210).]

3:20

4pSPb2. Alternative closeness functions for eye microphone array. Hedayat Alghassi (Dept. of Elec. and Comput. Eng., Univ. of British Columbia, Vancouver, BC, V6T 1Z4, Canada), Shahram Tafazoli and Peter Lawrence (Univ. of British Columbia, Vancouver, BC, V6T 1Z4, Canada)

A new signal processing algorithm, accompanied by a novel hemispherical microphone array structure for sound source localization in three-dimensional spaces was presented [H. Alghassi et al., "Acoustic source localization with eye array," JASA **120**(5) (2006)]. This localization methodology, which has some analogy to the eye in localization of light rays, uses concepts of two-microphone (pinhole) or three-microphone (lens) cell structures alongside a special closeness function (CF) to approximate the proximity of the sound source direction to each of the hemisphere microphone directions based on particular similarity measures among signals. The CF plays a major role in the accuracy of the final source direction estimation. The earlier multiplicative CF (MCF) operates based on vector multiplication of spatial derivative and time derivative of microphone signals. This work presents two additional categories of CFs and compares them with MCF. The difference CF (DCF) is based on subtraction of delayed reference signal and shell microphone signals, while the correlative CF (CCF) is based on multiplication of delayed reference signal and shell microphone signals. Similar to MCF, both DCF and CCF perform demonstrated linear output versus deviation angle. Although DCF and MCF have not shown improved experimental accuracy compared to MCF, they attained lower computational complexity.

3:35

4pSPb3. A space domain complex envelope. Choon-Su Park and Yang-Hann Kim (Novic Ctr., Dept. of ME, KAIST, 373-1 Guseong-dong, Yuseong-gu, Daejeon, Republic of Korea, yanghannkim@kaist.ac.kr)

Sound visualization tools, for example, beam forming and acoustic holography, exhibit the spatial look of sound in time or frequency domain. However, they normally require a significant amount of computation time to draw well the sound picture in space. The picture contains a great deal of information: Sound pressure distribution, intensity pattern, or energy information with respect to space. The information is often far more than what we need in practice. For example, when we want to know only the location of the sound sources and somewhat averaged sound pressure distribution, we need a means that can provide only what we need. The complex envelope in time domain can be a good starting idea to deal with the problems we have. A method to generate a spatial domain envelope has been theoretically developed. We found that the method not only has an advantage to show rather simple spatial sound distribution, but also reduce significantly the computation time. The latter makes it possible to see the sound picture faster than before: About ten times faster. This method has been applied to many practical examples: For example, sound from a musical instrument and sound from machinery.

3:50

4pSPb4. Acoustic source identification using a generalized regressive discrete Fourier series for tomographic reconstruction. Joris Vanherzeele, Roberto Longo, Steve Vanlanduit, and Patrick Guillaume (Dept. of Mech. Eng., Vrije Universiteit Brussel, Pleinlaan 2, 1050 Brussels, Belgium)

When measuring three-dimensional phenomena such as acoustic fields using an interferometric technique, one is prone to measure different angles of view to obtain a full three-dimensional representation of the phenomenon under investigation. This is due to the fact that an interferometric technique measures a line integral across the optical path. To obtain the full three-dimensional view, the different angles of view are passed through a tomographic algorithm. The most widely used tomographic method is filtered back projection. However, this process suffers from a series of drawbacks, the most important one being the fact that substantial truncation errors occur in the back projection step. In this article, a method is devised to eliminate these errors, based on a parametric frequency do-