In This Issue

This is the 10th issue of APSIPA Newsletter which we crown it by the news of the very generous donation contributed by Professor Sadaoki Furui of US$250,000 to APSIPA. Prof Furui was the founding president of APSIPA (Asia-Pacific Signal and Information Processing Association), serving from 2009 to 2012. The donation will be used to promote and recognize high quality papers in the APSIPA Transactions on Signal and Information Processing by establishing a best paper award, named APSIPA Sadaoki Furui Prize Paper Award. Please refer to page 2 of this issue for more information. We also introduce interesting research articles to steer the readers to some stimulating research lines in quick shots. The articles included in this issue are:

1. ‘On adopting parametric array loudspeakers in active noise control’, by Chuang Shi, Yoshinobu Kajikawa, and Waleed H. Abdulla
2. ‘Phonated speech reconstruction: a short review’, by Hamid Sharifzadeh and Ian V. McLoughlin
3. ‘Joint modelling of linguistic and paralinguistic information – A new paradigm’, by Eliathamby Ambikairajah, Vidhyasaharan Sethu and Julien Epps
4. ‘SEAME: LDC release of Mandarin-English code-switching speech data’, by Ho Thi Nga, Chng Eng Siong, Haizhou Li
5. ‘Error signal measurement in active noise control systems’, by Darshana Sheth and Iman Ardekani

These are in addition to the regular columns such as the announcement to APSIPA conference, APSIPA Transactions updates, and others. We hope you find it useful and enjoying to read in your spare time. Please feel free to send us comments and suggestions to improve our newsletter to benefit as much as possible our APSIPA community.

Finally, to every beginning there is an end and this is the last issue to end up my term as Editor-in-Chief of APSIPA newsletter which I have been holding since the time I proposed it to our community. I would like to thank all the people who supported me to fulfill my commitments in this role and I will continue supporting the newsletter to become better and better.

Waleed Abdulla
APSIPA Newsletter Editor-in-Chief
Abstract: Active noise control (ANC) creates a set of silent points at the location of error microphones. As a byproduct, a zone of quiet is created surrounding the silent points. Unfortunately, the extension of the created quite zone is small. Moreover, a large part of the quiet zone is occupied by the error microphones. Recently, a number of researchers have independently proposed to displace error microphones and move them outside the desired quite zones. This idea involves in the modification of ANC adaptive algorithms. This paper looks at available techniques that aims at the displacement of error microphones in ANC systems and conducts a comparison discussion about them.

1. Introduction

ANC utilizes an electroacoustic framework to cancel out the undesirable sound (noise) based on the superposition principle. In an ideal ANC system, a control system drives a loudspeaker to create a sound field that is equal in magnitude but opposite in phase with the original noise field. The superposition of the two fields results in silence. In practice, this idea can be only realized for a set a discrete points in the field. ANC has been focused in the control of low frequency noise, where the passive noise control systems are inefficient due to this fact that the noise wavelength is comparable with the dimensions of the acoustic barriers. ANC systems use adaptive filters to derive the cancelling loudspeaker. The most common adaptive filters used for ANC consists of a finite impulse response (FIR) filter with an LMS-type algorithm. In view point of control theory, ANC systems are classified in to two categories: feedforward and feedback. Feedforward ANC enjoys the knowledge of the noise field obtained through measurement in a location close to the noise source. Feedback ANC must estimate the noise field by using an internal model. As shown in Figure 1, a typical feedforward ANC system has a single reference microphone, a single cancelling loudspeaker, and a single error microphone. The reference microphone picks up a reference signal \( x(n) \). \( x(n) \) is filtered by the ANC adaptive filter to produce the anti-noise signal \( y(n) \) which is fed to the loudspeaker. The error microphone picks up the error signal \( e(n) \) which is the combination of the noise and anti-noise [1]. Feedforward ANC is usually more reliable than feedback ANC.

Error microphones play a significant role in ANC systems. The reference microphones can be removed from the system in feedback ANC. However, both feedforward and feedback ANC rely on the error signal

Figure 1. Single channel feedforward ANC
The error signal in the remote ANC system is different with the error signal in the original FxLMS based ANC system [8]. A mechanism for the compensation of this difference was proposed in [3] and [8], resulting in a new ANC algorithm, called Remote FxLMS (R FxLMS). Table 2 shows the simulation results obtained in different experiments. In each experiment a particular distance between the actual microphone and the location of interest is used. As seen, by moving the microphone further, the performance of remote ANC algorithm is degraded.

### C. Virtual microphone

As the zone of quiet produced at the physical error microphone is restricted in size for ANC, virtual acoustic sensors were created to move the zone of quiet to a desired area that is remote from physical error microphone. Utilizing the physical error signal, a virtual detecting algorithm is utilized to scale the weight at an improved virtual area. These moving virtual sensing algorithms evaluate the error signals at various virtual areas that travel through the sound field. Various moving virtual sensing algorithms have been produced including the spatially fixed virtual sensing algorithm, the remote moving error microphone technique [7], the adaptive LMS moving virtual error algorithm, and [8].

### Table 2. noise attenuation for remote ANC

<table>
<thead>
<tr>
<th>Algorithm</th>
<th>r=0cm</th>
<th>r=2cm</th>
<th>r=4cm</th>
</tr>
</thead>
<tbody>
<tr>
<td>R FxLMS</td>
<td>22db</td>
<td>20db</td>
<td>19db</td>
</tr>
</tbody>
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microphone technique [9] and the Kalman filtering moving virtual sensing technique [10]. ANC systems using this technique can be classified into two main categories: model-based and non-model-based. The former requires a model of the acoustic plant to process data picked up from microphones. An off-line acoustic modeling technique is necessary to reach the acoustic system model from physical sensors to remote sensors. Model-based techniques rely on the system model obtained offline; they are very sensitive to changing in the characteristics of the environment and noise. Non-model-based techniques do not use a model of the acoustic plant. Alternatively, they use characteristics of measured signal in order to estimate the error signal in a location of interest that is not physically accessible [5].

III. Conclusion

There are numerous difficulties in creating efficient quite zones by using ANC. Several techniques have been so far proposed; however, they have their own strengths and shortcomings. In moving error microphone approach, the Doppler Effect occurs with the speed of error microphone, resulting in the instability of the system. Virtual sensing techniques require more sophisticated algorithms that are computationally inefficient. Remote ANC approach that is the direct combination of ANC adaptive algorithm, and virtual sensing techniques looks promising as it can achieve a high attenuation degree by modification of the FxLMS algorithm.

IV. References


Ernst Florens Friedrich Chladni was a German physicist and musician. His most important work, for which he is sometimes labeled the "father of acoustics", included research on vibrating plates and the calculation of the speed of sound for different gases. He also undertook pioneering work in the study of meteorites and so is also regarded by some as the "father of meteoritics". One of Chladni's best-known achievements was inventing a technique to show the various modes of vibration of a rigid surface. When resonating, a plate or membrane is divided into regions that vibrate in opposite directions, bounded by lines where no vibration occurs (nodal lines). Chladni repeated the pioneering experiments of Robert Hooke who, on July 8, 1680, had observed the nodal patterns associated with the vibrations of glass plates. Hooke ran a violin bow along the edge of a plate covered with flour and saw the nodal patterns emerge. Chladni's technique, first published in 1787 in his book Entdeckungen über die Theorie des Klanges ("Discoveries in the Theory of Sound"), consisted of drawing a bow over a piece of metal whose surface was lightly covered with sand. The plate was bowed until it reached resonance, when the vibration causes the sand to move and concentrate along the nodal lines where the surface is still, outlining the nodal lines. The patterns formed by these lines are what are now called Chladni figures. Similar nodal patterns can also be found by assembling microscale materials on Faraday waves. Source: https://en.wikipedia.org/wiki/Ernst_Chladni