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Evaluation of Two-Channel Source Separation Using Exploratory Projection Pursuit Technique

(Penilaian Pemisahan Sumber Dua Saluran Menggunakan Teknik Exploratori *Projection Pursuit*)

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ABSTRACT

Difficulty of understanding speech in noise among the elderly necessitates the need for Auditory Training which has made a renewal of interest in the last decade with the auditory training applications. This interest is perhaps spurred by advances in computer-based technology. In computer-based auditory training, speech signals are considered as auditory training stimuli where input speech signals need to be verified prior to training as the speech signals are mixed with noise signals. Computer-based Auditory Training System can be embedded with input speech verifying module. Input speech verifying module is employed with speech and noise separator simulator. This simulator needs to guarantee accurate separation of speech from noise signals. Therefore, in this research, Exploratory Projection Pursuit (EPP) technique under semi-Blind Source Separation (BSS) method is intended to separate the speech source signals which are mixed with competing speech (multitalker speech babble). This training uses Malay language based sentences which differ in word length and hence number of sample values. The experimental simulation considers two-channel random, linear mixing of speech sources and competing speech. The aim of this study is to evaluate the performance of source separation using the anticipated EPP technique for various sample values of speech signals which varies in time duration due to word length dissimilarity. Simulation results show that EPP technique is feasible for source separation. As a consequence, high correlation value of $r \geq 0.99$ is obtained between extracted speech signal and original speech signal for all categories of speech signals. It is further verified by the maximum nongaussianity of extracted speech signal which has high kurtosis value of 32 approximately.

Keywords: Two-channel source separation; exploratory projection pursuit technique; computer-based auditory training; speech signal

ABSTRAK

Kesukaran memahami pertuturan dalam kalangan warga tua menyebabkan perlunya Latihan Auditori yang telah mendapat perhatian sejak sedekad yang lalu dengan aplikasi latihan auditori. Perhatian ini mungkin didorong oleh kemajuan dalam teknologi berasaskan komputer. Dalam latihan auditori berasaskan komputer, isyarat pertuturan dianggap sebagai rangsangan latihan auditori di mana input isyarat pertuturan perlu disahkan sebelum latihan sebagai isyarat pertuturan bercampur dengan isyarat hingar. Sistem Latihan Auditori berasaskan komputer boleh disertakan bersama modul pengesahan pertuturan input. Modul pengesahan pertuturan input digunakan dengan simulator pemisah pertuturan dan hingar. Simulator ini perlu menjamin pemisahan pertuturan yang tepat dari isyarat hingar. Oleh itu, dalam kajian ini, teknik Pengejaran Unjuran Exploratori (EPP) di bawah kaedah Pemisahan Sumber separa-Buta (BSS) bertujuan untuk memisahkan isyarat sumber pertuturan yang bercampur dengan pertuturan yang bersaing (pertuturan bebel multitalker). Latihan ini menggunakan ayat bahasa Melayu yang berbeza dari segi panjang perkataan dan nilai bilangan sampel. Simulasi uji kaji mengambil kira dua saluran secara rawak, pencampuran sumber pertuturan linear dan pertuturan bersaing. Tujuan kajian ini adalah untuk menilai prestasi pemisahan sumber menggunakan teknik EPP terjangka untuk pelbagai nilai sampel isyarat pertuturan yang berbeza-beza dalam tempoh masa disebabkan oleh perbezaan panjang perkataan. Hasil simulasi menunjukkan bahawa teknik EPP mampu untuk pemisahan sumber. Oleh itu, nilai korelasi $r \geq 0.99$ yang tinggi dapat diperolehi antara isyarat pertuturan yang disari dan isyarat pertuturan asal bagi semua kategori isyarat pertuturan. Ia selanjutnya disahkan oleh isyarat pertuturan nongaussianity maksimum yang disari yang mempunyai nilai kurtosis yang tinggi lebih kurang sebanyak 32.

Kata kunci: Pemisahan sumber dua saluran; teknik exploratori projection pursuit; latihan auditori berasaskan komputer, isyarat pertuturan

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