

**ENHANCEMENT OF COVER SELECTION – BASED AUDIO
STEGANOGRAPHY (CAS) USING BLOCK-BASED CHAOTIC
MULTI – LEVEL LSB (BCM– LSB) FOR BALANCED
PERFORMANCE**

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ABSTRAK

Steganografi merupakan satu teknik dalam keselamatan data dengan menyembunyikan maklumat dalam objek untuk mengelakkan pengesanan. Penyisipan bit terkurang bererti (BTB) ialah salah satu teknik steganografi audio yang telah diusulkan untuk menyembunyikan data dalam fail audio. Antara kelemahan BTB adalah rendahnya keselamatan dinamik. Dalam konsep asas steganografi audio, pengguna mungkin memilih pelindung audio yang rendah kualiti lantas mengurangkan kapasiti penyisipan, keteguhan, ketelusan dan keselamatan dinamik. Objektif penyelidikan ini adalah untuk mereka bentuk solusi untuk masalah steganografi audio ini. Penyelidikan ini kemudiannya mencadangkan klasifikasi baru untuk kaedah pemilihan pelindung berdasarkan tingkahlaku dan cara pemilihan mereka untuk mengenal pasti kekuatan dan kelemahan setiap klasifikasi. Pemilihan berasaskan kualiti pelindung kemudiannya dipilih untuk dilaksanakan. Penyisipan berasaskan blok dengan peta kacau dirumus untuk meningkatkan keselamatan dinamik steganografi audio BTB. Sementara untuk menangani isu pemilihan pelindung, penyelidikan ini merumuskan kriteria pemilihan berdasarkan keselamatan dinamik dan mereka bentuk kaedah pemilihan pelindung berdasarkan audio untuk memenuhi penggantian antara kapasiti, keteguhan, ketelusan dan keselamatan dinamik. Penyelesaian baru yang dikenali sebagai algoritma Steganografi Audio Berasaskan Pemilihan Pelindung (SABPP) yang terdiri daripada Pelbagai Peringkat BTB Kacau (PP-BTB-C) berasaskan blok dan Pemilihan Pelindung Audio Berasaskan Pelbagai Ciri (PPABPC) dibangunkan berdasarkan pemilihan berasaskan kualiti dan dinilai dengan menggabungkan secara khusus blok kacau dan mekanisme pelingkar untuk PP-BTB-C dan metrik pemilihan berbilang ciri serta Algoritma Genetik Isih Tidak Didominasi 2 (AGITD-II) untuk PPABPC. Perbandingan antara PP-BTB-C dengan tujuh (7) kaedah BTB yang lain berasaskan tujuh (7) pendekatan, prestasinya dari segi kapasiti penyisipan, keteguhan, ketelusan adalah setanding. Namun, ia menunjukkan kemampuan yang tinggi jauh meninggalkan kaedah yang lain dari segi keselamatan dinamik. Untuk kajian perbandingan tentang isu penggantian terhadap kaedah sedia ada yang tidak mengambil kira strategi penggantian, PPABPC berjaya memilih set pelindung dengan julat skor yang lebih baik antara 66% hingga 87%, di mana kaedah sedia ada yang terbaik hanya berjaya mencadangkan perlindungan dengan julat skor antara 47% hingga 83%. Bagi kajian perbandingan mengenai isu metrik keselamatan dinamik yang tidak tepat terhadap kaedah sedia ada, PPABPC berjaya memilih pelindung dengan julat skor yang lebih tinggi antara 33% hingga 71% manakala mereka hanya berjaya mencadangkan pelindung dengan julat skor 34% hingga 68%. Akhir sekali, perbandingan SABPP terhadap PP-BTB-C yang menggunakan tetapan rawak menunjukkan kemampuan SABPP kerana ia berjaya memilih pelindung dengan skor yang lebih tinggi berjulat antara 28% hingga 55% manakala PP-BTB-C yang menggunakan tetapan rawak hanya berjaya mencadangkan pelindung dengan julat markah 10% hingga 49%. Ia dapat disimpulkan bahawa algoritma SABPP yang terdiri daripada PP-BTB-C dan PPABPC boleh membantu dalam memilih perlindungan terbaik sambil mempertimbangkan penggantian dari segi kapasiti, ketelusan, keteguhan dan keselamatan dinamik.

ABSTRACT

Steganography is a technique in data security by hiding information in an object to avoid detection. Least Significant Bit (LSB) is one of the audio steganography techniques that have been proposed to conceal data within an audio file. The weakness of current LSB technique is low dynamic security. Concurrently, in the audio steganography fundamental concept, user may select poor cover audio which may reduce capacity, robustness, imperceptibility, or dynamic security. The objectives of this research are to design the solution for the audio steganography. This research then proposes a classification for cover selection methods based on their selection behaviour to identify strengths and weaknesses of each classification. Cover-quality-based selection is then selected to be implemented. Block embedding with chaotic map is formulated to enhance the dynamic security of LSB audio steganography. While to address the cover selection issues, this research formulated a dynamic security selection criteria and designed audio-based cover selection method to cater the trade-off between capacity, robustness, imperceptibility, and dynamic security. A solution known as Cover-selection-based Audio Steganography (CAS) algorithm which consists of Block-based Chaotic Multi-level LSB (BCM-LSB) and Multi-characteristic-based Cover Audio Selection (MCAS) is developed based on cover-quality-based selection and evaluated by incorporating specifically the chaotic block and rounding mechanism for the BCM-LSB and multi-characteristic selection metric and Non-dominated Sorting Genetic Algorithm 2 (NSGA-II) for the MCAS. Comparing BCM-LSB to other LSB methods based on seven (7) approaches, its performance in terms of capacity, imperceptibility, and robustness is comparable individually. However, in terms of dynamic security, BCM-LSB shows superior performance. For the comparison experiment on trade-off issues against existing methods that do not consider the trade-off, it is worth noting that MCAS managed to select set of covers with better score ranges between 66% up to 87%, in which the highest existing method only managed to suggest covers with score ranges between 47% up to 83%. While for the comparison experiment on the dynamic security inaccurate metric issue against existing method, MCAS managed to select covers with higher score ranges between 33% up to 71% while they only managed to suggest covers with score ranges 34% up to 68%. Lastly, a comparison experiment of CAS against BCM-LSB using random setting shows that the superiority of CAS as it managed to select covers with higher score ranges between 28% up to 55% while BCM-LSB using random setting only managed to suggest covers with score ranges 10% up to 49%. It is concluded that CAS algorithm that consists of BCM-LSB and MCAS could aid in selecting best cover while considering the trade off in terms of capacity, imperceptibility, robustness, and dynamic security.

الملخص

تخبئة البيانات بالصوت هي تقنية في أمن البيانات عن طريق إخفاء المعلومات في الكائنات لتجنب اكتشافه. يعد تضمين البنات الأقل هو إحدى تقنية تخبئة البيانات بالصوت التي تقترح لإخفاء البيانات في الملفات الصوتية. من بين نقاط الضعف في تضمين البنات الأقل، هو التقصير في الأمان الديناميكي. في المفهوم الأساسي لتخبئة البيانات بالصوت، قد يختار المستخدمون تدريجاً صوتياً منخفض الجودة مما يقلل من قدرة من بين نقاط الضعف في التضمين والمتانة والشفافية والأمان الديناميكي. الهدف من هذا البحث هي تصميم الحل لإخفاء الصوت. وطرق اختيار حامي الصوت. ثم يقترح هذا البحث تصنيفاً جديداً لطرق الاختيار الوقائي بناءً على سلوكهم وطرق الاختيار لتحديد نقاط القوة والضعف في كل تصنيف. ثم هذا الاختيار الذي يبنى على جودة الوقاية يُختار للتنفيذ. الإدراج المستند إلى الكتل مع الخرائط تُعرض لتزويد سلامة الديناميكي تخبئة البيانات بالصوت وبالإضافة إلى ذلك، يصيغ هذا البحث معايير اختيار قائمة على سلامة الديناميكي الجديدة ويصمم طريقة الاختيار الوقائي القائم على الصوت لتلبية المفاضلة بين السعة والمتانة والشفافية والأمان الديناميكي. الحل الجديد الذي يعرف ب خوارزمية إخفاء الصوت القائمة على اختيار الغلاف الذي يتكون من الفوضوي متعدد المستويات القائم على الكتلة واختيار صوت الغلاف متعدد الخصائص يُتطور المستند إلى جودة الغلاف وتقييمه من خلال دمج الكتلة الفوضوية وآلية التقريب لالفوضوي متعدد المستويات القائم على الكتلة ومقياس الاختيار متعدد الخصائص و الخوارزمية الجينية للفرز ير المسيطر عليها لإختيار صوت الغلاف متعدد الخصائص مقارنة بين مراحل مختلفة من فوضوي متعدد المستويات القائم على الكتلة. مع سبعة طرق تضمين البنات الأقل أخرى التي تعتمد على سبعة مناهج ، أداءها من حيث سعة الإدخال والمتانة والشفافية قابل للمقارنة. ولكن ، فإنه يظهر قدرة عالية على ترك الأساليب الأخرى من حيث الأمان الديناميكي. من أجل دراسة مقارنة حول مسألة من اختيار مجموعة واقية ذات استبدال لأساليب الحالية التي لا تأخذ بعين الاعتبار المقايضة ، تمكنت نطاق درجات أفضل بين 66% إلى 87% ، حيث اقترح اختيار واقية الصوت على أساس كتلة ومتعددة الميزات تباين الأساليب الحالية التي لا تأخذ بعين الاعتبار المقايضة الحماية بنجاح بنطاق نقاط بين 47% إلى 83%. لإجراء دراسة مقارنة حول قضية مقياس الأمان الديناميكية غير في اختيار واقيات 71% إلى 33% ، نجح الدقيقة ضد الاختلافات في طريقة أعلى طريقة موجودة بينما اختيار واقيات الصوت على أساس الخصائص المتعددة اقترحوا بنطاق درجات أعلى من بنجاح واقيات بنطاق نقاط من 34% إلى 68%. أخيراً ، تُظهر مقارنة مقابل خوارزمية إخفاء الصوت

فوضوي متعدد المستويات القائم على الكتلة الذي يستخدم إعدادات القائمة على التحديد الوقائي عشوائية قدرة خوارزمية إخفاء الصوت القائمة على التحديد الوقائي لأنه ينجح في اختيار واقيات ذات درجات أعلى تتراوح من 28% إلى 55% بينما ينجح فوضوي متعدد المستويات القائم على الكتلة الذي يستخدم إعدادًا عشوائيًا فقط اقترح واقيات بنجاح بنطاق نقاط من 10% إلى 49%. يمكن أن تساعد MCAS و BCM-LSB التي تتكون من CAS تم التوصل إلى أن خوارزمية في اختيار أفضل غطاء مع مراعاة المفاضلة من حيث السعة، وعدم القدرة على الإدراك، والمتانة، والأمن الديناميكي

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LIST OF ABBREVIATIONS

LSB	Least Significant Bit
BCM-LSB	Block-based Chaotic Multi-level LSB
MCAS	Multi-characteristic-based Cover Audio Selection
CAS	Cover-selection-based Audio Steganography
HVS	Human Visual System
HAS	Human Auditory System
AWGN	Additive White Gaussian Noise
Seg-SNR	Segmental Signal to Noise Ratio
SNR	Signal to Noise Ratio
MPI	Most Prominent Idea
NPGA II	Niched Pareto Genetic Algorithm II
NSGA	Non-dominated Sorting Genetic Algorithm
NSGA-II	Non-dominated Sorting Genetic Algorithm II
SPEA	Strength Pareto Evolutionary Algorithm
SPEA2	Strength Pareto Evolutionary Algorithm 2
MSE	Mean Squared Error
PSNR	Peak Signal to Noise Ratio
BER	Bit Error Rate