DEDICATION

To my mother, whose strength and positive attitude toward life inspires me.

To my father, who taught me the importance of education.
ACKNOWLEDGMENT

I would like to thank my thesis supervisor, Dr. OMER E. H. HAMID, for giving me the chance to explore a research career in biomedical engineering. His continual support, technical insight, and dedication to this research has made this opportunity most enjoyable.
ABSTRACT

Eye blinks and movements of the eyeballs produce electrical signals that are collectively known as Ocular Artifacts (OA) and these are 10-100 times stronger than EEG signal which is being recorded. Removing artifacts from EEG signal may aid the work of doctors, because artifacts disturb their attention. This research presents a new method to remove automatically ocular artifacts in contaminated EEG signals. The method is based on Recursive Least Square (RLS) Adaptive Filter through stationary wavelet transform (SWT). The stationary wavelet transform (SWT) is used as a pre-stage before the Recursive Least Square (RLS) Adaptive Filtering, to produce ocular artifact free EEG signal. The results show that, in some cases, the method is 20 times better when compared to the use of the traditional FFT method of removing ocular artifacts.
المستخلص

إغماض وفتح العين وحركة العين ينتج إشارات كهربية تعرف بتشويش العين. وهذه الإشارات أكبر من إشارات المخ بقار يتراوح بين 10 إلى 100 مرة. التخلص من هذا التشويش عند تسجيل وتخطيط إشارات المخ يسهل من عمل الأطباء. هذا البحث يقدم طريقة إتوماتيكية جديدة لإزالة هذا التشويش من إشارات المخ. تُبنى هذه الطريقة على المرشحات التكثيفية التكرارية من خلال تحويل الموجات الثابتة. تحويل الموجات الثابت استخدم كمرحلة أولية قبل مرحلة المرشحات التكثيفية التكرارية للحصول على تسجيل إشارات مخ خال من تشويش العين. وُجد أن النتائج تعطي ترشيح أفضل 20 مرة في بعض نطاق التردد لإشارات المخ مقارنة بالطريقة التقليدية التي تعتمد على تحويل فوريير السريع.
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ABBREVIATIONS

CWT    Continuous wavelet transform
DWT    Discrete wavelet transform
ECG    Electrocardiogram
EEG    Electroencephalogram
EOG    Electrooculogram
FFT    Fast fourier transform
FIR    Finite impulse response
FT     Fourier transform
GUI    Graphical user interface
ICA    Independent component analysis
LMS    Least mean square
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>PCA</td>
<td>Principal component analysis</td>
</tr>
<tr>
<td>RLS</td>
<td>Recursive least square</td>
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<tr>
<td>SOS</td>
<td>Second order statistics</td>
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<tr>
<td>STFT</td>
<td>Short time fourier transform</td>
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<tr>
<td>SURE</td>
<td>Stein’s unbiased risk estimate</td>
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<tr>
<td>SWT</td>
<td>Stationary wavelet transform</td>
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<tr>
<td>TFA</td>
<td>Time frequency analysis</td>
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