RAJEEV GANDHI MEMORIAL COLLEGE OF ENGINEERING AND TECHNOLOGY
(AUTONOMOUS)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

CO-PO Mapping of Project in the area of Application of Digital Signal Processing

Title of the Project: Removal of EOG Artifacts and Separation of Different Cerebral Activity Components from Single Channel EEG.

Area of the Project: Digital Signal Processing

Methodology: Simulation

Name of the Supervisor: Mr. S. KHASIM NOOR BASHA M.Tech, (Ph.D).,

Name of the Students:

V. MANASWI (19091A04A1)
B. LAKSHMI (20095A0408)
K.S SATHEESH (20095A0416)
S. SAI HEMANTH (19091A04H0)

Abstract:

The electroencephalogram (EEG) signals are usually interfered by many sources of noise like electrooculogram (EOG), which degrades the signals of interest. It causes the poor performance of the Brain-Computer Interface (BCI) systems. In this work, the problem of removal of EOG artifacts and separation of different cerebral activities found in a single-channel contaminated EEG is addressed. For this purpose, a novel model, based on the combined use of Singular Spectrum Analysis (SSA) and Independent Component Analysis (ICA) with a Stationary Wavelet Transform (SWT) is presented. ICA technique is a highly efficient method, which deals with the multichannel EEG signals. But it is difficult to apply the ICA on single channel EEG. Hence, using SSA, the single channel contaminated EEG signals are converted into multivariate information. Then, the multivariate information is fed to ICA, which separates the source signals as different independent components (ICs). Despite the fact that the ICA method performs excellent source separation, still, some required EEG signal content is present in the IC representing itself as an artifact, and thus dropping it would cause loss of EEG signal content. To avoid this problem, SWT is applied on the artifact IC, which performs the thresholding, to separate the actual artifact and preserve the EEG signal content. MATLAB simulations have been done on both synthetically generated and real-life EEG signals and the proposed model is compared with the existing works. It is demonstrated that the proposed model has the best artifact separation performance than all the existing techniques, which is shown in terms of the metric, RRMSE (Relative Root Mean Square Error).

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Process of CO-PO attainment for Project thesis of IV-year Main Project

Course Outcomes:

[1] To identify the problem formulation of the project after literature surveyor study of existing technology
[2] To analyze the basic concepts of the project in correlation with theengineering knowledge
[3] To apply the concepts of technology with modern tool usage to overcomethe problem.
[4] To formulate the solution and to design simulation and prototype of thesolution with the engineering knowledge.

CO-PO Mapping:

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2
CO1	2	-	-	-	-	-	-	-	3	-	-	-
CO2	2	-	2	-	-	-	-	-	3	-	-	-
CO3	2	-	-	-	-	-	-	-	3	-	3	-
CO4	2	-	2	-	2	-	-	-	3	-	3	-

Evaluation:

Projectwork	100	External evaluation	This end viva voce in project work for 100 marks
	25	Internal evaluation	These 25 marks will be based on the performance ofthe student in the project reviews apart from attendance and regularity

Table: Percentage Weightages for each CO

S.No.	REG	IM 25M	EM grade	TM 125M	EM 100M	%IM	%EM	CO1	CO2	CO3	CO4	N.CO1	N.CO2	N.CO3	N.CO4
1	19091A04A1	23	10	118	95	92	95	22.56	34.08	18.88	18.88	84.62	102.25	94.44	94.44
2	20095A0408	22	9	112	90	88	90	21.44	32.32	17.92	17.92	80.42	96.96	89.64	89.64
3	20095A0416	19	8	98	79	76	79	18.72	28.32	15.68	15.68	70.21	84.96	78.43	78.43
4	19091A04H0	18	7	87	69	72	69	16.8	24.96	13.92	13.92	63.01	74.88	69.63	69.63

Table: Weightage marks for each CO

	CO1	CO2	CO3	CO4
Internal	40	20	20	20
External	20	40	20	20
Average	26.66	33.33	19.99	19.99

Table: Percentage Attainment Values for each CO

	CO1		CO2		CO3		CO4	
Above & Equal 60%	3	3	3	3	3	3	3	3
Between 40-60%	0	2	0	2	0	2	0	2
Below40%	0	1	0	1	0	1	0	1
Total students	4		4		4		4	
Attainment value		3.00		3.00		3.00		3.00
% of attainment		100.00		100.00		100.00		100.00
Attained or not (Greater 50% Y, Not Means N)		Y		Y		Y		Y

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A PROJECT REPORT ON

REMOVAL OF EOG ARTIFACTS AND SEPARATION OF DIFFERENT CEREBRAL ACTIVITY COMPONENTS FROM SINGLE CHANNEL EEG

Submitted in partial fulfilment of requirement for the award of the degree of

BACHELOR OF TECHNOLOGY
IN

ELECTRONICS & COMMUNICATION ENGINEERING

Submitted by

V. MANASWI	19091A04A1
B. LAKSHMI	20095A0408
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S. SAI HEMANTH	19091A04H0

Under the Guidance of

Mr. S. Khasim Noor Basha, M. Tech. (Ph. D)

Assistant Professor in ECE Department

(ESTD-1995)

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CERTIFICATE

This is to certify that V. Manaswi (19091A04A1),B. Lakshmi (20095A0408), K S. Satheesh (20095A0416),S. Sai Hemanth (19091A0402) of B.Tech ECE final year has carried out the project work on "Removal of EOG artifacts and separation of different cerebral activity from signal channel EEG" under the esteemed guidance of **Mr. S. Khasim Noor Basha**, **Assistant Professor** of ECE department, for the partial fulfilment of the award of degree of B.Tech in ECE in R.G.M.C.E.T, Nandyal as a bonafide record of work carried by them under our guidance and supervision.

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Project Guide

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Date: 05/05/23

ABSTRACT

The electroencephalogram (EEG) signals are usually interfered by many sources of noise like electrooculogram (EOG), which degrades the signals of interest. It causes the poor performance of the Brain–Computer Interface (BCI) systems. In this work, the problem of removal of EOG artifacts and separation of different cerebral activities found in a single-channel contaminated EEG is addressed. For this purpose, a novel model, based on the combined use of Singular Spectrum Analysis (SSA) and Independent Component Analysis (ICA) with a Stationary Wavelet Transform (SWT) is presented. ICA technique is a highly efficient method, which deals with the multichannel EEG signals. But it is difficult to apply the ICA on single channel EEG. Hence, using SSA, the single channel contaminated EEG signals are converted into multivariate information. Then, the multivariate information is fed to ICA, which separates the source signals as different independent components (ICs). Despite the fact that the ICA method performs excellent source separation, still, some required EEG signal content is present in the IC representing itself as an artifact, and thus dropping it would cause loss of EEG signal content. To avoid this problem, SWT is applied on the artifact IC, which performs the thresholding, to separate the actual artifact and preserve the EEG signal content. Matlab simulations have been done on both synthetically generated and real-life EEG signals and the proposed model is compared with the existing works. It is demonstrated that the proposed model has the best artifact separation performance than all the existing techniques, which is shown in terms of the metric, RRMSE (Relative Root Mean Square Error).

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CHAPTER – 6

CONCLUSION AND FUTURE SCOPE

6.1 Conclusion

The joint use of SSA–ICA with wavelet thresholding technique ispresented in this work, to remove EOG artifact and to separate differentactivity components from single channel contaminated signal. Simulation results show that the proposedtechnique is more efficient to separate the sources whencompared with the existing techniques such as EEMD, EEMD-ICA, SSA and SSA – ICA. The main advantage of the proposed SSA–ICA with wavelet thresholding technique is that, it retrieves the EEG component in αband with high accuracy along with the separation of differentcerebralactivity components available in mixed EEG. Simulation results onsynthetic and real EEG data demonstrate the efficiency of the proposedtechnique over existing methods in terms of RRMSE and MAE. Hence, itcan be concluded that the SSA–ICA with wavelet thresholding method has the capability of operating on single channel EEG signals withoutaltering the EEG α component, and thus it can be applied for BCIapplications.

6.2 Future scope

In our proposed algorithm it contains three stages,hence this algorithm complexity will increases.So in future number of stages will be reduce by introducing simplified algorithms.

SSA algorithm having the high computation complexity, so in future we will replace the SSA algorithm with less computational algorithms.

In second stage of SSA,SVD is there so in future we will introduce the higher order SVD which will effectively identified the artifact than the SVD.

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