



© 2019

Proceedings of the 10th National Technical Seminar on Underwater System Technology 2018

NUSYS'18

Editors: Md Zain, Z., Ahmad, H., Pebrianti, d., Mustafa, M., Abdullah, N.R.H., Samad, R., Mat Noh, M. (Eds.)

ISSN 2194-5357 ISSN 2194-5365 (electronic)
Advances in Intelligent Systems and Computing
ISBN 978-3-030-00978-6 ISBN 978-3-030-00979-3 (eBook)
<https://doi.org/10.1007/978-3-030-00979-3>

Library of Congress Control Number: 2018955576

© Springer Nature Switzerland AG 2019

This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, express or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Contents

Electromyograph (EMG) Signal Analysis to Predict Muscle Fatigue During Driving	405
Muhammad Amzar Syazani Mohd Azli, Mahfuzah Mustafa, Rafiuddin Abdubrani, Amran Abdul Hadi, Syarifah Nor Aqida Syed Ahmad and Zarith Liyana Zahari	
Time-Frequency Analysis from Earthing Application	421
Jun Hou Ting, Mahfuzah Mustafa, Zarith Liyana Zahari, Dwi Pebrianti, Zainah Md Zain, Nurul Hazlina Noordin and Rafiuddin Abdubrani	
Energy Spectral Density Analysis of Muscle Fatigue	437
Noor Aisyah Ab Rahman, Mahfuzah Mustafa, Rosdiyana Samad, Nor Rul Hasma Abdullah and Norizam Sulaiman	
Modelling Automatic IoT Home Light System (SmartLi) by NODEMCU ESP8266	447
Muhammad Muttaqin A. Rahim, Nor Shazwanie Ramli, Najwa Raihana Abdul Wahab and Rohana Abdul Karim	
Development of Automated Gate Using Automatic License Plate Recognition System	459
Luai Taha Ahmed Al-Mahbashi, Nurhafizah Abu Talip Yusof, Syamimi Shaharum, Mohamad Shaiful Abdul Karim and Ahmad Afif Mohd Faudzi	
Design of T-Shaped UWB Antenna with Dual Band Rejection Using Inverted U- and C-Shaped Slots	467
Salwa Awang Akbar, Ahmad Syahiman Mohd Shah, Ahmad Afif Mohd Faudzi, Sabira Khatun, Syamimi Mardiah Shaharum, Nurhafizah Abu Talip @ Yusof and Mohamad Shaiful Abdul Karim	
Inter Vehicle Communication System for Collision Avoidance	475
Nurul H. Noordin, Althea C. Y. Hui, Nurulfadzilah Hassan and Rosdiyana Samad	

Electromyograph (EMG) Signal Analysis to Predict Muscle Fatigue During Driving

Muhammad Amzar Syazani Mohd Azli¹, Mahfuzah Mustafa¹, Rafiuddin Abdubrani¹,
Amran Abdul Hadi¹, Syarifah Nor Aqida Syed Ahmad¹, Zarith Liyana Zahari^{1,2}

¹ Univerisiti Malaysia Pahang, Pahang, Malaysia

²Universiti Kuala Lumpur British Malaysian Institute, Selangor, Malaysia
mahfuzah@ump.edu.my

Abstract. Electromyography (EMG) signal obtained from muscles need advance methods for detection, processing and classification. The purpose of this paper is to analyze muscle fatigue from EMG signals. At beginning, 15 subjects will answer a set of questionnaires. The score of the questionnaires will be calculated and the score will determine if the driver is fatigue or mild fatigue or fatigue based on their driving habit. Next, EMG signals will be collected by placing two surface electrodes on the Brachioradialis muscle located at the forearm while driving Need For Speed (NFS) game. A simulation set of steering and pedals will be controlled during the driving game. The drivers drive for two hours and the EMG signal will be collected during they are driving. The output signals will be pre-process to remove any noise in the signal. After that, the data is normalized between value 0 to 1 and the signal is analyzed using frequency analysis and time analysis. Mean and variance will be calculated for time domain analysis and graph of mean vs variance is plotted. In frequency domain analysis, Power Spectral Density (PSD) is extracted from the peak frequency of PSD in each signal is obtained. All result will be divided into three classes: non-fatigue, mild-fatigue and fatigue. Based on result obtained in time domain, average normalized mean (non-fatigue: 0.5004), (mild-fatigue: 0.497) and (fatigue: 0.494). While, for frequency domain analysis, average peak frequency (non-fatigue: 13.379Hz), (mild-fatigue: 11.969Hz) and (fatigue: 12.782Hz).

Keywords: EMG, muscle fatigue, driver fatigue, time-domain, frequency-domain.

1 INTRODUCTION

Muscle fatigue is the decrease in ability of a muscle to generate force. Muscle fatigue can cause to road accident Usually, muscle fatigue in driving will occur when the driver drive for a long period of time. According to statistic from Malaysia Institute of Road Safety Research (MIROS), in 2016, 521466 total accidents were reported. These crashes resulted in 1.38% deaths [1]. Muscle fatigue is one of the factor contributes to the road accident. Muscle fatigue is common problem faced by most of the drivers. Muscle fatigue can cause the driver to fall asleep or muscle cannot function well during