# MECHATRONICS BOOK SERIES

## CONTROL AND INTELLIGENT SYSTEMS

Momoh Jimoh E. Salami
Abiodun Musa Aibinu
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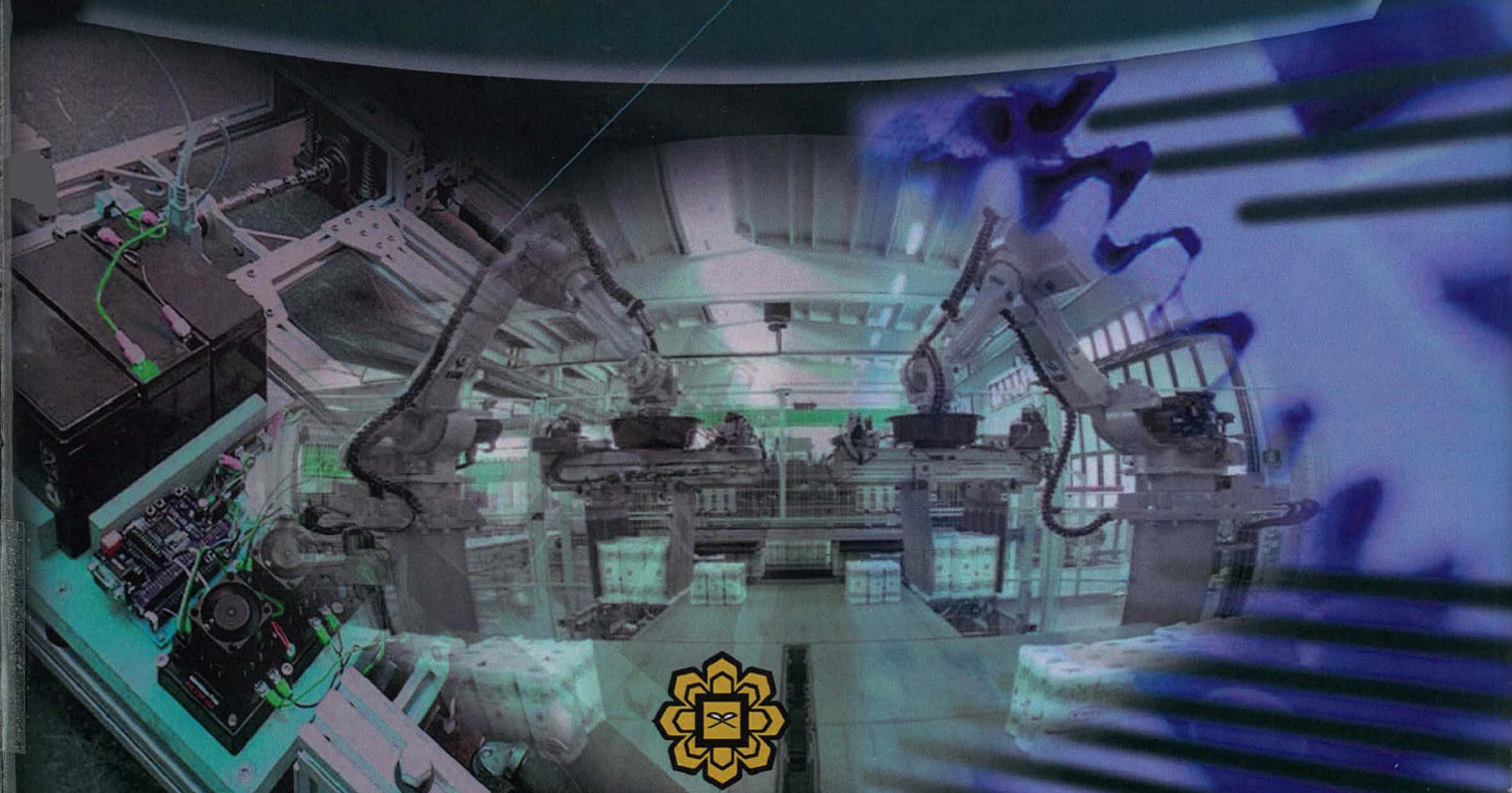

IIUM Press
INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA

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**IIUM Press**

Published by:
IIUM Press
International Islamic University Malaysia

First Edition, 2011


Perpustakaan Negara Malaysia Cataloguing-in-Publication Data

Momoh Jimoh E. Salami, Abiodun Musa Aibinu, Yasir Mohd Mustafah: Mechatronics Book Series: Control and Intelligent Systems
Bibliography p.
Includes Index
ISBN

ISBN: 978-967-418-176-5

Member of Majlis Penerbitan Ilmiah Malaysia – MAPIM
(Malaysian Scholarly Publishing Council)

Printed by :
**IIUM PRINTING SDN.BHD.**
No. 1, Jalan Industri Batu Caves 1/3
Taman Perindustrian Batu Caves
Batu Caves Centre Point
68100 Batu Caves
Selangor Darul Ehsan
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# Chapter 40
# Advanced Noise Removal Techniques for the Detection of EMG Signal

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## 40.1 Introduction

Electromyography (EMG) is the study of muscle function through the inquiry of the electrical signal the muscles generate. EMG signal is the electrical muscle activity that reflects the physiological behavior of the neuromuscular system upon certain excitation. The brain and spinal cord constitute the central nervous system. The axon or nerve fiber maintains a communication link between spinal nerve and muscle fiber and it is responsible for controlling muscle contraction. When an electrical impulse generated in the central nervous system reaches to a muscle fiber through an axon, a contraction is triggered through a biochemical process. As a result of this process, a transient drop of electrical potential occurs across the membrane of fibers. This potential drop is termed as action potential. After that, all the fibers of same motor unit are triggered simultaneously and the recorded action potential is the summations of all action potentials of the muscle fibers which belong to the triggered motor unit. This muscle unit action potential (MUAP) can be detected by a surface electrode (non-invasive) attached to the skin over the muscle of interest, or by a needle electrode (invasive) inserted in the muscle of interest [1]. When detecting and recording the EMG signal as a train of MUAP, there are two major factors related to the fidelity of the signal. The first term is the signal-to-noise (SNR) which describes the strength of EMG signals with respect to the strength of the noise signal. Generally, noise is the unwanted electrical or electromagnetic energy that degrades the quality of desired EMG signal. The other factor involved with in distortion of the signal, i.e. any frequency component which has relative contribution to the EMG signal [2].

## Materials and Methods

**Noise and Artifacts in EMG Signal:** Generally, the acquired EMG signal has the amplitude range up to 10mV peak to peak (±5mV) before amplification process [2]. Before reaching the electrode terminals, the electrochemical process propagates through nerve fibers. Hence, the EMG signals can be easily contaminated by various noises while passing through different fibers. Further amplification of this low amplitude signals may lead to participation of noise and artifacts to the electronic circuitry of the instrument. Some of the source of noise/artifacts can be managed by proper detection methods, whereas the current technology cannot easily regulate other sources. It is only possible to consider and assume their potential effect on signal. For the effective analysis of signal, it is very important to understand the sources and their influences on the signal [3].Some of the sources of noise/artifact and their removal techniques are discussed below.