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# **MMG Sensor for Muscle Activity Detection – Low Cost Design, Implementation and Experimentation**

By

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## Abstract

There is always a demand for cheaper, simpler and more effective human-machine interfaces. Currently, the most reliable and common muscle activity sensor is the EMG. The EMG is an expensive and complex piece of equipment which is far from ideal all round solution.

The purpose of this research is to explore various methods of muscle activity detection and using the information gathered design and implement a sensor capable of detecting muscle activation. The major focus is on mechanomyography (MMG), the measurement of mechanical response of muscle during muscle activity. It is well documented that muscles produce low frequency vibrations (5 – 100Hz) during muscle activity. A microphone is able to capture these vibrations when they reach the surface of the skin.

The prototype sensor consists of a microphone, microphone preamplifier, low pass Butterworth hardware filter, data acquisition hardware and accompanying data acquisition software.

During the experimentation phase, we explored various documented muscle events and phenomena, both general muscle events and ones unique exclusively to MMG. This includes things such as muscle fatigue, exponential relationship between force and vibration, and any other undocumented events. This experimentation also helped determine the effectiveness of the sensor.

Testing showed that periods of muscle activity were clearly visible and there was a definitely relationship between the force and vibrations, however there were shortcomings in terms of the sensor design. This included finding a better method of attaching the sensor to the surface of the skin, the dimension deformations of the muscle caused unwanted artefacts in the results and muscle fatigue was not observed. Despite its imperfections, it can be concluded that the design and implementation was a limited success.

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Martin Ma.

I, Martin Ma, hereby declare that this thesis, unless otherwise stated, is of my own work. External sources of work have been referenced and acknowledged accordingly.

Signature:

Date:        /        /

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## **List of Abbreviations**

MMG – Mechanomyography

AMG – Acoustic Myography

EMG – Electromyography

PEC or PE – Piezoelectric

ACC – Accelerometer

HMI – Human-Machine Interface

DAQ – Data Acquisition