

# MECHATRONICS BOOK SERIES

## CONTROL AND INTELLIGENT SYSTEMS

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Momoh Jimoh E. Salami  
Abiodun Musa Aibinu  
Yasir Mohd Mustafah



IIUM Press

INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA

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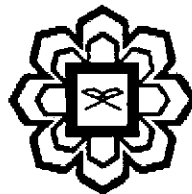
# CONTROL AND INTELLIGENT SYSTEMS

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**Momoh Jimoh E. Salami**

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**Yasir Mohd Mustafah**



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## Chapter 34

### Determination of Material Depth Using Artificial Neural Network

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#### 34.1 Introduction

Defect identification in any industry is a crucial phase in the manufacturing process. For this purpose, Non Destructive Testing (NDT) technique, which is the inspection of the material in a manner that will not make it unsuitable for further service, is employed[1]. This testing is carried out at the time of production for quality control or when the component is in service for troubleshooting and maintenance.

Although, there are many NDT techniques that are studied and practiced, each method is suited to detecting particular faults. The most common NDT methods are eddy current, ultrasonic and radiography depending on the applications and the concerned material under test.[2] For this project three methods are implemented namely, eddy current, ultrasonic and infrared. A brief summary of the methods is given below.

**34.1.1 Eddy current (EC)** testing is essentially a near-surface technique for the inspection of metallic parts. In standard eddy current testing, a circular coil carrying an AC current is placed in close proximity to an electrically conductive specimen [3]. The alternating current in the coil generates a changing magnetic field, which interacts with the test object and induces eddy currents. Variations in the phase and magnitude of these eddy currents can be monitored using a second 'search' coil, or by measuring changes to the current flowing in the primary 'excitation' coil. [4] Variations in the electrical conductivity or magnetic permeability of the test object, or the presence of any flaws, will cause a change in eddy current flow and a corresponding change in the phase and amplitude of the measured current. This is the basis of standard (flat coil) eddy current inspection, the most widely used eddy current technique.[5]

**34.1.2 Ultrasonic** testing involves sending high frequency vibrations (100 kHz to 200 kHz) through a material and sensing their reflections [6]. Ultrasonic testing involves sending high frequency vibrations (100 kHz to 200 kHz) through a material and sensing their reflections. The high frequency vibrations are produced by a transducer, which uses a piezoelectric crystal to convert electrical oscillations into mechanical vibrations [6]. The transducer is placed on the surface of the material to be tested. Vibrations penetrate the material and are refracted and reflected at discontinuities within the material. Another transducer picks up the reflected signal which is displayed on an oscilloscope. The resulting reflection indicates the internal integrity of the test specimen.

**34.1.3 Infrared Emission** is a detection system for identifying surface irregularities such as cracks, pits, scratches in a part that is made of a material having a relatively high reflectivity and a relatively low emissivity such as titanium, aluminium etc [7]. An infrared transmitter generates an infrared signal on the surface of the part to be tested. The infrared signal generates an output voltage corresponding to the infrared signal reflected by the surface. A display that is connected to the infrared receiver displays the corresponding voltage of the infrared signal. This voltage is compared to a threshold voltage to declare the surface irregularity. The voltage is lower for deeper crack and vice versa.