

**MECHATRONICS BOOK SERIES**  
**SELECTED PAPERS FROM**  
**ICOM'01, ICOM'05 AND**  
**ICOM'08**

---

**Editors**

Asan G. A. Muthalif  
Amir A. Shafie  
Momoh J.E. Salami



IIUM Pres

Published by:  
IIUM Press  
International Islamic University Malaysia

First Edition, 2011  
©IIUM Press, IIUM

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without any prior written permission of the publisher.

Perpustakaan Negara Malaysia

Cataloguing-in-Publication Data

ISBN: 978-967-0225-68-5

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

# CONTENTS

## CHAPTER ONE: Mechatronics System Design and Applications

Title	Conference	Page
Automation of Pump Test Rig System <i>Ahmad Faris Ismail, Iskandar Al Thani Mahmood, and Tasneem Pervez</i>	ICOM'01	3
Auto Cruise System: A System to Assist During Traffic Congestion <i>Taufik Yunahar, Ahmad Imran Ibrahim, Asan Gani</i>	ICOM'05	17
Low Cost SCADA System With Auto Fault Detection Using Micro Controller <i>M. Azman Shah, Khalid A. S. Al-Khateeb, And M. F. Mohammad</i>	ICOM'05	24
Traffic Light Sequencing - An Element Of Adaptability <i>Sheroz Khan, Othman O Khalifa And Azuki Abdul Salam</i>	ICOM'05	32
Thermal Shock in Periodic Edge-Cracked Plate Supported by Elastic Foundation <i>Abd El-Fattah A. Rizk</i>	ICOM'05	38
Design and Development of an Automatic Car Door Opening and Locking System <i>Md. Ataur Rahman, A.K.M Mohiuddin, Irwan, Azoa and Adly</i>	ICOM'08	48
Development Of Unmanned Vehicle Utilizing GPS System <i>M. H. Ali, S.B Abdul Hamid, M. A. Rahman</i>	ICOM'08	53
Design Of An Autopilot For An Autonomous Unmanned Aerial Vehicle <i>M. Idres and R. Kafafy</i>	ICOM'08	59

CHAPTER TWO: Modelling and Simulation

Title	Conference	Page
Finite Element Study of Composite Cones Under Axial Compression Loading <i>Asad A. Khalid, Ahmad F. Ismail and Nurul Amin A. K. M</i>	ICOM'01	69
Design and Analysis of a Solar Still Using Finite Element Method <i>M. I. Ahmed, Y. A. Abakar, T. Pervez and A. F. Ismail</i>	ICOM'01	79
Anisotropic Laminated Composite Theory for Delamination Analysis of Curved Bar <i>T. Pervez and M. I. Ahmad</i>	ICOM'01	90
Free Vibration of Variable Thickness Plates Using Characteristic Orthogonal Polynomial Strip Functions Subjected to Different Combinations of Boundary Conditions <i>Abd El-Fattah A. Rizk, Ahmed S. Ashour</i>	ICOM'01	101
Using Spline Path in Real Time Navigation Simulations Systems, in Continuous Space <i>Ahmed Mustafa, Aisha-Hassan A. Hashim and Othman Khalifa</i>	ICOM'08	112
Semi-Active Suspension System for Off-Road Vehicles <i>Zohir BenLahcene, Waleed F Faris, MD Raisuddin Khan and S.I. Ihsan</i>		119

CHAPTER THREE: Intelligent Systems

Title	Conference	Page
Intelligent Keystroke Pressure-Based Typing Biometrics Authentication System using Multilayer Feed-forward Network <i>A. Sulong, Wahyudi and M.U. Siddiqi</i>	ICOM'08	131

Proposed Intelligent Algorithm for IC Marking Image Inspection <i>Yasser H. and M. J. E. Salami</i>	ICOM'08	138
The Role of Intelligent Systems in Mechatronics Engineering <i>Nahrul Khair Alang Md Rashid</i>	ICOM'08	144

#### CHAPTER FOUR: Instrumentation, Dynamics and Control

Title	Conference	Page
Hardware Implementation of Intelligent Braking System <i>S. N. Sidek and M. J. E. Salami</i>	ICOM'01	151
Design And Implementation of Dsp-Based Hybrid Controller for Some Motion Applications <i>Yusuf I. Bulale, M.J.E Salami</i>	ICOM'01	156
Fuzzy Logic Based Controller for Maintaining Human Comfort within Intelligent Building System <i>Nasrodin .T. Mustapha, Momoh J. E. Salami, Nazim M. Nasiri</i>	ICOM'05	167
Design and Implementation of Fuzzy Logic Controller for Intelligent Gantry Crane System <i>Wahyudi and J. Jalani</i>	ICOM'05	173
The Use of Scanning Electron Microscope in Evaluating Insulation Property <i>A.G..E. Sutjipto , Afzeri , R. Muhida , I. Sopyan 1 &amp; E. Haruman</i>	ICOM'05	180
A Maximum Power Point Tracking for Photovoltaic System Using Temperature Compensator Method <i>Riza Muhida, Wahyudi Martono, Afzeri, Esa Haruman, Iis Sopyan , Abdul Gani Albagul and Agus Geter Edy Sutjipto</i>	ICOM'05	187
Neural Network Controlled of an Active Engine Mounting System Using a Nonlinear Electromagnetic Actuator <i>Fadly J.D., Wahyudi M. and Waleed F. Faris</i>	ICOM'08	194

A High Linearity CMOS RF Amplifier for Power Control Module in RFID Reader (ICOM 2008)	ICOM'08	203
<i>M. J. Uddin, M.A. Hasan, M. I. Ibrahimy, A. N. Nordin, M. A. M. Ali and M. B. I. Reaz</i>		
Design and Implementation of Fuzzy Control for Two Link Flexible Manipulator	ICOM'08	209
<i>Waleed F. Faris, Wahyudi Martono and Omar H. J. Hajjaj</i>		
State Feedback Control Tuning for Flexible Joint Manipulator Using PSO with Constraint	ICOM'08	215
<i>Mahmud Iwan S., Andika Aji Wijaya, Wahyudi</i>		
Fuzzy-based NCTF Controller for PTP Positioning: Fuzzy Membership and Rule Based Modifications	ICOM'08	223
<i>Purtojo, Rini Akmelawati and Wahyudi</i>		
Analysis of Magnetorheological Brake System with a Fuzzy Logic Controller	ICOM'08	231
<i>M.M.Rashid, Momoh J. E. Salami, M.A.Abd. Rahim and M.A.Hussain</i>		
Neural-tuned PID Control for Point-to-point (PTP) Positioning System	ICOM'08	237
<i>Wali Ahmad @ Myo Min Htut and Wahyudi</i>		

#### CHAPTER FIVE: Machine Vision

Title	Conference	Page
Review of Image Processing in Industrial Inspection and Quality Control (ICOM 2005)	ICOM'05	245
<i>Othman O. Khalifa and Sheroz Khan</i>		
Recognition of Handwritten Arabic Characters: Challenges and Prospective (ICOM 2005)	ICOM'05	250
<i>Sarra M. Abd Al-Rahim, Othman O Khalifa</i>		

A Review of Path Detection in Intelligent Video Surveillance	ICOM'08	258
--	---------	-----

*Imran Moez Khan, Yusof Zaw Zaw, Othman O. Khalifa and Lai Weng Kin*

#### CHAPTER SIX: Speech and Image processing

Title	Conference	Page
Reduction of Motion Artifact in Portable Pulse Oximetry (ICOM 2008)	ICOM'08	267
<i>H. Malek, Othman O. Khalifa and I. Muhammad</i>		
Lossless Audio Compression using Psychoacoustic Model and Wavelet Transform (ICOM 2008)	ICOM'08	274
<i>Othman O. Khalifa, Sering Habib Harding and Aisha-Hassun A. Hasim</i>		
An Isolated Character Segmentation Approach (ICOM 2008)	ICOM'08	283
<i>Assma O. H. Ayyad, Othman O. Khalifa and Aisha Hassan</i>		
A study of Independent Component Analysis Applicability to Fetal Heart Rate Detection Using Photolethysmogarph (ICOM 2008)	ICOM'08	288
<i>H. Malek, Othman O. Khalifa and M. A. Mohd Ali</i>		
Educational Project on a Simple Voice Identification Using Frequency Cepstrum Coefficients and Vector Quantization (ICOM 2008)	ICOM'08	294
<i>H. K. Widhiputranto and R. Akmeliawati</i>		

#### CHAPTER SEVEN: Robotics and Automation

Title	Conference	Page
Movement Analysis for Building Intelligent Reactive Navigation Behaviours for Legged Robot	ICOM'01	303
<i>Adel Ali S. Al-Jumaily</i>		
Conceptual Design and Kinematic Analysis of Robotic Differential Gripper	ICOM'01	317
<i>Sameh Farag M. Ghobashi, Nazim Mir-Nasiri</i>		

Design Of Scara-Type Multi-Loop Robotic Arm <i>Nazim Mir-Nasiri</i>	ICOM'01	324
Humanoid Robot Head <i>A. A. Shafie, M.N. Kasyfi, N. I. Taufik Y.</i>	ICOM'08	331
Development of Mobile Photovoltaic Robot for Exploring Disaster Area <i>Riza Muhida, Suhaimi B Mohd Zaid, Wahyudi, Rifki Muhida, Ari Legowo and Akhmad Unggul</i>	ICOM'08	338
Investigation of a Novel Type of Locomotion for a Snake Robot Suited for Narrow Spaces <i>M. Watanabe, M.R. Khan</i>	ICOM'08	346
Cooperative Robot and User Friendly Robot- New Challenge in Robotics (ICOM 2008) <i>Md. Mozasser Rahman and Md. Raisuddin Khan</i>	ICOM'08	353
Inverse Kinematics of a Hyper-Redundant Robotic Manipulator <i>Syed Musrur Ahamad, Md. Raisuddin Khan, Md. Mozasser Rahman</i>	ICOM'08	358
A Gait Transition Method for Hexapod Robots <i>Md. Masum Billah, Dr. Mohiuddin Ahmed, Soheli Farhana</i>	ICOM'08	364

#### CHAPTER EIGHT: MEMS and Materials

Title	Conference	Page
Quality of Cu Film Electrodeposited on Silicon Wafer Using Different Current Densities <i>Shahjahan Mridha</i>	ICOM'05	373
Trimming of Atomic Force Microscope Probe Tip by Ion Milling <i>M. Y. Ali and B. H. Lim</i>	ICOM'05	381
Selection of Materials and Design Specification for Hip Joint Prosthesis <i>I. Sopyan, E. Haruman, A.G.E. Sutjipto, and R. Muhida</i>	ICOM'05	386



Generalized One-Dimensional Flow Inside Thermo-Electrically Controlled Micronozzle	ICOM'08	394
<i>Amar Hasan H and Raed Kafafy</i>		

#### CHAPTER NINE: MEMS and Materials

Title	Conference	Page
Intelligent Generator for Semi-Actual Test Data	ICOM'01	403
<i>Shihab A.Hameed, Abdul Majid A.Al-Abbasi</i>		
Improving Software Testing by Using Statistical Methods to General Multi-Structures Test Data	ICOM'01	414
<i>Shihab A.Hameed</i>		
Cellular Radio Based Vehicular Location Finding	ICOM'01	426
<i>Farhat Anwar</i>		
Controlling Electrical Appliances Using Global Mobile System	ICOM'05	439
<i>Sheroz Khan, Muhammad Fawzi bin Husin, Mohd Halim bin Mohd Noor</i>		
An Autonomous Integrated Architecture for the Next Generation Air Traffic Management and Avionics Systems	ICOM'05	444
<i>I Ahmed, M. J Sadiq</i>		
Overview of Radio Frequency Microelectromechanical Systems Reconfigurable Antennas	ICOM'05	450
<i>A.H.M. Zahirul Alam</i>		
Integrated Emergency and Guidance System Based on WiMAX Wireless Technology (IEGSW)	ICOM'05	458
<i>S. A. Hameed and B. A. Aliyu</i>		
Harmful Data Factors that Affect Internet's Users in Educational Industry	ICOM'05	466
<i>Shihab A. Hameed</i>		
Web based Documentation System for Dynamic Roadmaps	ICOM'05	472
<i>Sajid Hassan, Mohammad Ahsan Chishti, Farhat Anwar, Chandran Elamvazuthi</i>		

The Power of Web Portals as a Gateway to Resources and <i>Shihab A. Hameed, Mohammad Ahsan Chishti</i>	ICOM'05	480
Smart Antenna Design: An Overview <i>Zuhani Ismail Khan and Md Rafiqul Islam</i>	ICOM'05	486
Performance Study of Intra-Domain Mobility Management <i>Nazreen Rusli, Fauzana Ridzuan, Aisha Hassan Abdalla Hashim and Sajid Hassan</i>	ICOM'05	493
Performance Evaluation of Hierarchical Mobile IP <i>Aisha Hassan Abdalla, Farhat Anwar, Shaffiah Mohd, Hatina Banun Liyakthulikhhan, Sajid Hassan</i>	ICOM'05	500

CHAPTER TEN: MEMS and Materials

Title	Conference	Page
Machine Condition Monitoring and Fault Diagnosis Using Spectral Analysis Techniques <i>M.J.E. Salami, Asan Gani and T. Pervez</i>	ICOM'01	509
Development of a New Method of Crack Modeling and Prediction Algorithm <i>A. M. Aibinu, A. A. Shafie, M. J. E. Salami, A.F. Salami, I. A. Bamgbopa and W. A. Lawal</i>	ICOM'08	520
An Overview of Pulse Oximetry System for Noninvasive Monitoring <i>Muslim A. Abu-Umar, Liban A. Kassim and Othman O. Khalifa</i>	ICOM'08	528

CHAPTER ELEVEN: MEMS and Materials

Title	Conference	Page
Effect of Cooling Rate on Properties of Commercially Pure Aluminium <i>Faisal A. Rahim, Nur Izan Syahriah Bt. Hussein and M. M. Haque</i>	ICOM'01	535

Investigation of Chatter Arising during End Milling Operation on VMC and Quality of Machined Surface <i>A.K.M.N. Amin, M.A. Rizal, M. Razman</i>	ICOM'01	542
Surface Roughness of Carbides Produced by Water Abrasive Jet Machining <i>Ahsan Ali Khan, Mohd Efendee Bin Awang, Ahmad Azwari Bin Annuar</i>	ICOM'05	556
An Integrated Approach of Computer Aided Design, Rapid Prototyping and Investment Casting <i>M. M. Haque, Azdy M. Arshad and Irzal K. Helme</i>	ICOM'05	562
Pin Type Reconfigurable Clamping Ability Evaluation for Setup- Free Technology <i>Afzeri, A.G. E Sutjipto, A.K.M Nurul Amin, Riza Muhida</i>	ICOM'05	569
Workpiece Preheating Approach to Reduce Chatter and Improve Machinability of Titanium Alloy - Ti6Al4V <i>A. K. M. Nurul Amin, K. Kamaruddin, M. Abdelgadir</i>	ICOM'05	576
Effect of Processing Force on Architecture And Impact Strength of Glass Fiber Reinforced Epoxy Composites <i>A. Nazrin, S. Mridha and Mohamad A. Rahman</i>	ICOM'05	583
Investigations of the Causes of Chatter in Computer Aided Manufacturing Process during End Milling Operation <i>Md. Anayet U Patwari, A.K.M. Nurul Amin, Waleed Faris, S. Alam</i>	ICOM'08	591

## Smart Antenna Design: An Overview

Zuhani Ismail Khan and Md Rafiqul Islam

Department of Electrical and Computer Engineering  
Faculty of Engineering, International Islamic University Malaysia  
Jalan Gombak, 53100 Kuala Lumpur, Malaysia  
[rafiq@iiu.edu.my](mailto:rafiq@iiu.edu.my)

### ABSTRACT

This paper reviews smart antenna systems, its features and benefits. It summarizes the challenges in designing the smart antenna and highlights the requirements and strategies those are needed in designing the future smart antenna systems.

### 1. INTRODUCTION

In the development of the telecommunication systems, the design of the next generation of wireless systems is vital. It will be based upon the new concept of fast, reconfigurable networks, supporting features such as high data rates, user mobility, adaptability to varying network conditions, and integration of a number of wireless access technologies. As the demand in this field increases, it has motivated the recent research towards the development of algorithms and standards that exploit space selectivity [1]. This results many efforts on the design of “smart” antenna arrays and the associated beamforming algorithm.

#### 1.1 Analogy for Smart Antenna

To have a good understanding of how an adaptive antenna system works, someone can close his/her eyes and converse with someone as he/she moves about the room. That person will notice that the location can be determined without seeing the person because of the following:

- The speaker's signals arriving through the two ears. It acts like an acoustic sensor.
- The voice arrives at each ear at a different time.
- The brain, a specialized signal processor, does a large number of calculations to correlate information and compute the location of the speaker.

The brain also adds the strength of the signals from each ear together, so you perceive sound in one chosen direction as being twice as loud as everything else. Adaptive antenna systems do the same thing, using antenna instead of the ears and a digital signal processor instead of the brain. Therefore after the digital signal processor receives the time delays from each antenna element: it computes the direction of arrival (DOA) of the signal of interest (SOI) [2]. It then adjusts the excitations (the amplitude and the phase of the signals) to produce a radiation pattern that focuses on the signal of interest SOI, while tuning out any signal not of interest (SNOI) [2].

### 2. SMART ANTENNA SYSTEMS

Various aspects of a smart antenna system technology include intelligent antennas, phased array, SDMA, spatial processing, digital beamforming, adaptive antenna system, and others. The following are distinction between the two major categories of smart antennas regarding the choices in transmit strategy: