About the Authors

Dr.M.Narender is working as a Professor at Computer Science and Engineering in TKR College of Engineering &Technology, Hyderabad. Totally he has 15 years of experience in teaching field, and has published 18 papers in SCI & Scopus Indexed International Journals. He received Ph.D (CSE) Degree from Sri Satya Sai University of Technology and Medical Sciences in 2017, M.Tech (SE) from Jawaharlal Nehru Technological University in 2010 and B.Tech(CSIT) from Jawaharlal Nehru Technological University in 2004.

Dr.Anuradha Pawar is an accomplished professional currently serving as an Assistant Professor and Training & Placement Officer at MIT Academy of Engineering, Alandi (Pune), have 14 years of teaching experience in engineering and polytechnic colleges in India . She holds a Ph.D. in Electronics and Communications Engineering from SAGE University, Indore, with a focus on "Efficient DDoS Attack Detection Using Ensemble of Neural Networks." She has also completed her MBA in Human Resource Management, along with an M.E. in Electronics & Communication. With a robust background in network security, cybersecurity, project management, and industry collaboration, she excels in various technical and management subjects. Dr. Pawar's expertise lies in problem-solving, time management, and leadership. She is recognized for her contributions in network security and training & organizational development, fostering growth in educational and corporate environments. Proficient in various IT applications and programming languages, she actively participates in professional bodies.

Dr.Vignesh Venkataraman, is an Associate Professor in the Department of Computer Science and Engineering, Karpagam College of Engineering, Coimbatore, India. He has more than 21 years of enriching teaching and research experience. He bagged the Indian Icon Award 2022 for the outstanding professor, Course Topper Award on "Applied IIOT from L&T Infotech, Indian Researcher Award 2021 from International Research Association. His vigorous research interest is in the field of Networking. He is a reviewer for Journal of Super Computing – Springer, International Journal of Computational Intelligence and Applications, International Journal of System Assurance Engineering and Management. He has contributed to more than 20 research papers in peer-reviewed International journals and refereed conferences organized by various professional bodies around the globe. He authored few Engineering books and has three patent publications to his credit.

Dr.Vikram Patil received B.E. (Electronics), M.E. (Electronics/ Comp. Appli.) in 1987 and 1994 respectively from Shivaji University Kolhapur, and Ph.D. from Bharati Vidyapeeth University Pune (M.S.) India in 2010. He is having 36 years of experience in Education at different level and at different institutes, out of which 12 years as Principal/Director in different Institutes. He has published over 40 papers in National/International Conferences/Journals, delivered talks in FDPs and Conferences. Certified for many MOOCs by NPTEL, as well NPTEL star performer in two categories. His research interests are Mobile Communication, Mobile Computing, Wireless Networks, and Cryptography.

ISBN

9 788119 313952

AASAN PUBLICATIONS | www.aasans.com | publisher@aasans.com

CRYPTOGRAPHY AND NETWORK SECURITY

CRYPTOGRAPHY AND NETWORK SECURITY

Dr. M. Narender | Dr Anuradha Pawar
Dr. Vignesh V. | Dr. Vikram Patil

About the Authors

Dr.J.S.Prasath working as Associate Professor in the Department of Electronics and Communication Engineering, SR International Institute of Technology, Hyderabad has about 18 years of teaching experience. He received his B.E degree in Electronics and Instrumentation Engineering with distinction from Bharath Niketan Engineering College, Madurai Kamaraj University, M.E degree in Process Control and Instrumentation Engineering with distinction from Annamalai University, Chidambaram and Ph.D. degree in Embedded Systems and Internet of Things based Continuous Process Plant Data Security from Hindustan Institute of Technology and Science, Chennai. He has published 20 research papers in refereed international journals, 15 research papers in the proceedings of various international conferences and two patents. He has received Best Teacher award in the Ideal Teaching Award Programme - 2022 held in KITS Engineering College, Ramachandrapuram, Andhra Pradesh, Best Paper awards for his research innovation from Indian Technology Congress and Ford Technology Solutions. His areas of research include Embedded Systems, Wireless Sensor Networks, Internet of Things, Process Control and Industrial Automation. He is an active member of ISTE.

Dr.G.Petchinathan Professor and Head, Department of Biomedical Engineering, Sri Shanmugha College of Engineering and Technology, Sankari, Salem District, have 18 years of teaching experience in universities and colleges in India and abroad. He has completed a B.E. degree in Instrumentation and Control Engineering, from Madurai Kamaraj University, Tamilnadu, India, in 2002 and a M.E. degree in Electrical Engineering from Jadavpur University, Kolkata, West Bengal, India, in 2007. He has completed a PhD degree from the Kalasalingam Academy of Research and Education, Tamilnadu, India, in 2016. His research area of interest includes intelligent control, controller tuning, system identification, evolutionary optimization techniques, model reference adaptive controllers, and the internet of things.

Dr.Sabeen S working in the Department of Computer Science, CSH, SRM Institute of Science and Technology. He received his Doctoral degree from Anna University in the year 2012. He received his post graduate degree MCA in the year 2002 and M.Tech. (CSE) in the year 2013. He has 22 years of teaching experience in various engineering colleges, Mohamad Sathak Engineering College, Noorul Islam College of Engineering, Jaya Engineering College and Sidharth Institute of Engineering and Technology, India. He is a life member of ISTE. His area of interests includes Data Mining, IoT, Machine Learning. He has published many papers in international journals. He has guided more than 100 projects for the post graduate students.

Dr.M.Narender is working as a Professor at Computer Science and Engineering in TKR College of Engineering &Technology, Hyderabad. Totally he has 15 years of experience in teaching field, and has published 18 papers in SCI & Scopus indexed international Journals. He received Ph.D (CSE) Degree from Sri Satya Sai University of Technology and Medical Sciences in 2017, M.Tech (SE) from Jawaharlal Nehru Technological University in 2010 and B.Tec h(CSIT) from Jawaharlal Nehru Technological University in 2004.

AASAN PUBLICATIONS
www.aasans.com
publisher@aasans.com

INTERNET OF THINGS: ARCHITECTURE, PROTOCOLS AND APPLICATIONS

INTERNET OF THINGS: ARCHITECTURE, PROTOCOLS AND APPLICATIONS

Dr.J.S.Prasath | Dr.G.Petchinathan
Dr.Sabeen S | Dr.M.Narender

About the Authors

Dr.T.Venkata Naga Jayudu working as Associate Professor in the Department of Computer Science and Engineering at Srinivasa Ramanujan Institute of Technology (SRIT), Anantapur, Andhra Pradesh. He completed his Ph.D from Jawaharlal Nehru Technological University Anantapur (JNTUA), Anantapur. He received M.Tech degree in computer science from JNTUA, Anantapur. He received B.Tech degree in Computer Science and Information Technology from JNTUH, Hyderabad. He has presented papers in various National/International conferences and published more than 20 papers in reputed journals. He got patents on emerging technologies in computer science and certified in many advanced courses in computer science. His research interest is Wireless Sensor Networks, Mobile Ad-Hoc Networks, Network Security, Machine Learning and data Science.

Chaganti B N Lakshmi has been working as a Professor in TKR College of Engineering and Technology from 2018. She did M.Tech from JNTU-Hyderabad and Ph.D. from Rayalaseema University, Kurnool, Andhra Pradesh, India. She has 21 years of teaching experience. Her research interests include Wireless sensor networks and Machine learning. She has publications in SCI/SCIE & SCOPUS indexed and other peer-reviewed journals; Conferences, and Indian Patents. She is a Life member of professional bodies like ISTE, IETE and IAENG.

Dr.Aparna Joshi working as Assistant professor in Department of Computer Engineering, Pimpri Chinchwad College of Engineering Pune ,Maharashtra ,India. She is having 18 years of teaching experience. Cloud Computing, Cyber Security, Machine Learning are her area of interest. She has also published 30 plus quality research papers, articles, book chapters in various indexed journals. She has completed her PhD in Computer Science and Engineering from Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology, Chennai, Tamilnadu, India. She has obtained both Master and Bachelor degree in Computer Science & Engineering from University of Pune, Maharashtra, India.

Mr.Nichenametla Rajesh working as Assistant professor in Department of Artificial Intelligence and Data Science, Koneru Lakshmaiah Education Foundation, Vaddeswaram, Guntur, Andhra Pradesh. He Completed his B.Tech and M.Tech from JNTU in Computer Science and Engineering, pursuing Ph.D in KL University in Machine and Deep Learning research area, and published 8 Scopus index papers and 1 patent in his account. He is currently working as Assistant Professor in KL Deemed to be University. His research of interests are Machine learning, Deep learning and Data analytics.

DJ ACADEME
We Make Your Profile
DECCAN INTERNATIONAL ACADEMIC PUBLISHERS
A MSME REGISTERED COMPANY | ISO 9001 2015 CERTIFIED COMPANY
INDIA
WEBSITE:HTTP://DIAPPUBLISHERS.COM
EMAIL:INFO@DIAPPUBLISHERS.COM, EDITOR@DIAPPUBLISHERS.COM
ISBN 978-81-967670-8-2
9 788196 767082

OPERATING SYSTEMS PRINCIPLES & PRACTICES FOR BEGINNERS

Dr. T. Venkata Naga Jayudu | Chaganti B N Lakshmi
Dr. Aparna Joshi | Mr.Nichenametla Rajesh

Operating Systems Principles & Practices for Beginners

Dr. T. Venkata Naga Jayudu | Chaganti B N Lakshmi
Dr. Aparna Joshi | Mr.Nichenametla Rajesh

DJ ACADEME
We Build Your Profile
DECCAN INTERNATIONAL ACADEMIC PUBLISHER

DECCAN INTERNATIONAL ACADEMIC PUBLISHERS

ISO 9001 2015 CERTIFIED COMPANY
MSME REGISTERED COMPANY
website :http://diappublishers.com/
e-mail:info@diappublishers.com,editor@diappublishers.com

Certificate

Of Publication

This is to certify that

Dr. Chaganti B N Lakshmi, *Professor*
TKR College of Engineering and Technology

PUBLISHED A BOOK ENTITLED

OPERATING SYSTEMS PRINCIPLES & PRACTICES FOR BEGINNERS

ISBN:978-81-967670-8-2

...ESTD. 2014...
DECCAN INTRTNATIONAL ACEDEMIC PUBLISHERS
HTTP://DIAPPUBLISHERS.COM/

Editor-in-Chief

International Conference on Advances in Computational Intelligence
ICACI - 2023

Department of Information Technology

Maturi Venkata Subba Rao (MVSR) Engineering College

(An Autonomous Institution, Sponsored by Matrusri Educational Society)

Springer

CERTIFICATE
of Appreciation

This certificate is proudly presented to

Narender Machha

in recognition for outstanding contribution as Reviewer *for a Two day "International Conference on Advances in Computational Intelligence (ICACI) 2023" organized on 15th & 16th of December 2023 by Department of IT, MVSREC, Hyderabad, Telangana State, India – 501510.*

Dr. A. V. Krishna Prasad
Convener, ICACI – 2023

Dr. K. Venu Gopala Rao
Chair, ICACI – 2023

Dr. G. Kanaka Durga
Principal, MVSREC

K. A. SURESH RAO
HEAD OF THE DEPARTMENT
Dept. of Computer Science & Engineering
T.K.R. College of Engineering & Technology
Meerpet, Hyderabad-500 097.

PRINCIPAL
TKR College of Engineering & Technology
(AUTONOMOUS)
Medbowli, Meerpet, Hyderabad- 500097.

KASIREDDY NARAYANREDDY COLLEGE OF ENGINEERING & RESEARCH.
(Approved by AICTE & Affiliated to JNTUH)
Abdullapur (V), Abdullapurmet (M), R.R Dist, 501505,Telangana, INDIA.
Email : principal@knrcer.ac.in ; website: www.knrcer.ac.in

To.

Dt:16-12-2023

Dr.M.Narender
Professor,
Department of Computer Science & Engineering
T K R College Of Engineering and Technology

Subject: Invitation to Speak as a Guest Lecturer-reg

Dear Sir,

I hope this message finds you well. I am writing to extend an invitation for you to serve as a guest lecturer at Kasireddy Narayanreddy College of Engineering and Research. We have been following your work in the field of computer science with great admiration, and we believe that your insights and expertise would be invaluable to our audience.

Event Details: *Guest Lecturer*

Date: 19-12-2023

Time: 9:30

Location (if in-person): Kasireddy Narayanreddy College of Engineering and Research, Abdullapurmet.

Proposed Topic:

We are particularly interested in having you speak on the topic of **Deep Learning and Neural Networks**. Your knowledge and experience in this area align perfectly with our event's goals and objectives.

Logistical Support:

We are committed to making your participation as smooth and enjoyable as possible. We will provide all necessary technical support and materials for your presentation. If you have any specific requirements or requests, please let us know, and we will do our best to accommodate them.

RSVP:

We kindly request that you confirm your availability by 18-12-2023. If you have any questions or need further information, please feel free to contact us at 9848850426.

We are excited about the possibility of having you join us as a guest lecturer and share your knowledge with our audience. Your contribution would undoubtedly enhance the quality of our event.

Thank you for considering our invitation, and we hope to hear from you soon.

Sincerely,
P.Satish Reddy
Head of the Department

Head of the Department
CSE Department
Computer Science & Engineering
K.N.R.C.E.R. & Research
Abdullapurmet (V), R.R. Dist-501 505

Dr. A. SURESH RAO
HEAD OF THE DEPARTMENT
Dept. of Computer Science & Engineering
T.K.R. College of Engineering & Technol-
Meerpet, Hyderabad-500 097

International Conference on Advances in Computational Intelligence
ICACI - 2023

Department of Information Technology
Maturi Venkata Subba Rao (MVSR) Engineering College
(An Autonomous Institution, Sponsored by Matrusri Educational Society)

Springer

CERTIFICATE
of Appreciation

This certificate is proudly presented to

Dr. K. S. R. Radhika

in recognition for outstanding contribution as Reviewer *for a Two day "International Conference on Advances in Computational Intelligence (ICACI) 2023" organized on 15th & 16th of December 2023 by Department of IT, MVSREC, Hyderabad, Telangana State, India – 501510.*

Dr. A. V. Krishna Prasad	Dr. K. Venu Gopala Rao	Dr. G. Kanaka Durga
Convener, ICACI – 2023	Chair, ICACI – 2023	Principal, MVSREC

D. A. SURESH RAO
HEAD OF THE DEPARTMENT
Dept. of Computer Science & Engineering
T.K.R. College of Engineering & Technology
Meerpet, Hyderabad-500 097.

PRINCIPAL
TKR College of Engineering & Technology
(AUTONOMOUS)
Medbowli, Meerpet, Hyderabad- 500097.

HOLY MARY INSTITUTE OF TECHNOLOGY AND SCIENCE

(UGC-Autonomous)

Accredited by NAAC-'A' Grade, Approved by AICTE, New Delhi.

SERB sponsored Two Days National Seminar

on

IoT and Machine Learning Based

Smart Grid Technology For Future Energy Management

Certificate of Participation

This is to certify that Mr./Ms./Mrs./Dr. **Jyothi Madanaboina**

from **TKRCET** has participated in the "**IoT AND MACHINE LEARNING BASED SMART GRID TECHNOLOGY FOR FUTURE ENERGY MANAGEMENT**". TWO-DAYS National Seminar Event Organized by **SCIENCE AND ENGINEERING RESEARCH BOARD , INDIA** along with **HOLY MARY INSTITUTE OF TECHNOLOGY AND SCIENCE**, Bogaram(V),Keesara(M),Medchal Dist., Hyderabad, Telangana, . The event is held on **28th & 29th JUNE,2024.**

Dr. G. Venkatakoti Reddy CO-Convenor HITS	Dr. M. Saravanan Convenor HITS	Dr. J.B.V.Subrahmanyam Principal HITS

Dr. A. SURESH RAO
HEAD OF THE DEPARTMENT
Dept. of Computer Science & Engineering
T.K.R. College of Engineering & Technology
Meerpet, Hyderabad-500 097.

PRINCIPAL
TKR College of Engineering & Technology
(AUTONOMOUS)
Medbowli, Meerpet, Hyderabad- 500097.

HOLY MARY INSTITUTE OF TECHNOLOGY AND SCIENCE

(UGC-Autonomous)

Accredited by NAAC-'A' Grade, Approved by AICTE, New Delhi.

SERB sponsored Two Days National Seminar

on

IoT and Machine Learning Based

Smart Grid Technology For Future Energy Management

Azadi Ka Amrit Mahotsav

INSTITUTION'S INNOVATION COUNCIL (Ministry of Education Initiative)

Certificate of Participation

This is to certify that Mr./Ms./Mrs./Dr. **Vasannagari Pavani**

from **TKRCET** has participated in the "**IoT AND MACHINE LEARNING BASED SMART GRID TECHNOLOGY FOR FUTURE ENERGY MANAGEMENT**". TWO-DAYS National Seminar Event Organized by **SCIENCE AND ENGINEERING RESEARCH BOARD , INDIA** along with **HOLY MARY INSTITUTE OF TECHNOLOGY AND SCIENCE**, Bogaram(V),Keesara(M),Medchal Dist., Hyderabad, Telangana, . The event is held on **28th & 29th JUNE,2024.**

Dr. G. Venkatakoti Reddy CO-Convenor HITS	Dr. M. Saravanan Convenor HITS	Dr. J.B.V.Subrahmanyam Principal HITS

HEAD OF THE DEPARTMENT
Dept. of Computer Science & Engineering
T.K.R. College of Engineering & Technology
Meerpet, Hyderabad-500 097.

PRINCIPAL
TKR College of Engineering & Technology
(AUTONOMOUS)
Medbowli, Meerpet, Hyderabad- 500097.

HOLY MARY INSTITUTE OF TECHNOLOGY AND SCIENCE

(UGC-Autonomous)

Accredited by NAAC-'A' Grade, Approved by AICTE, New Delhi.

SERB sponsored Two Days National Seminar

on

IoT and Machine Learning Based

Smart Grid Technology For Future Energy Management

Azadi Ka Amrit Mahotsav

INSTITUTION'S INNOVATION COUNCIL (Ministry of Education Initiative)

Certificate of Participation

This is to certify that Mr./Ms./Mrs./Dr. **P LAXMI PRASANNA**

from **TKRCET** has participated in the "**IoT AND MACHINE LEARNING BASED SMART GRID TECHNOLOGY FOR FUTURE ENERGY MANAGEMENT**". TWO-DAYS National Seminar Event Organized by **SCIENCE AND ENGINEERING RESEARCH BOARD , INDIA** along with **HOLY MARY INSTITUTE OF TECHNOLOGY AND SCIENCE**, Bogaram(V),Keesara(M),Medchal Dist., Hyderabad, Telangana, . The event is held on **28th & 29th JUNE,2024.**

Dr. G. Venkatakoti Reddy
CO-Convenor
HITS

Dr. M. Saravanan
Convenor
HITS

Dr. J.B.V.Subrahmanyam
Principal
HITS

Dr. A. SURESH RAO
HEAD OF THE DEPARTMENT
Dept. of Computer Science & Engineering
T.K.R. College of Engineering & Technology
Meerpet, Hyderabad-500 097

PRINCIPAL
TKR College of Engineering & Technology
(AUTONOMOUS)
Medbowli, Meerpet, Hyderabad- 500097.

HOLY MARY INSTITUTE OF TECHNOLOGY AND SCIENCE

(UGC-Autonomous)

Accredited by NAAC-'A' Grade, Approved by AICTE, New Delhi.

SERB sponsored Two Days National Seminar

on

IoT and Machine Learning Based

Smart Grid Technology For Future Energy Management

Azadi Ka Amrit Mahotsav

INSTITUTION'S INNOVATION COUNCIL (Ministry of Education Initiative)

Certificate of Participation

This is to certify that Mr./Ms./Mrs./Dr. **Anantha Lakshmi Gali**

from **TKRCET** has participated in the "**IoT AND MACHINE LEARNING BASED SMART GRID TECHNOLOGY FOR FUTURE ENERGY MANAGEMENT**". TWO-DAYS National Seminar Event Organized by **SCIENCE AND ENGINEERING RESEARCH BOARD , INDIA** along with **HOLY MARY INSTITUTE OF TECHNOLOGY AND SCIENCE**, Bogaram(V),Keesara(M),Medchal Dist., Hyderabad, Telangana, . The event is held on **28th & 29th JUNE,2024.**

Dr. G. Venkatakoti Reddy
CO-Convenor
HITS

Dr. M. Saravanan
Convenor
HITS

Dr. J.B.V.Subrahmanyam
Principal
HITS

Dr. A. SURESH RAO
HEAD OF THE DEPARTMENT
Dept. of Computer Science & Engineering
T.K.R. College of Engineering & Technology
Meerpet, Hyderabad-500 097.

PRINCIPAL
TKR College of Engineering & Technology
(AUTONOMOUS)
Medbowli, Meerpet, Hyderabad- 500097.

HOLY MARY INSTITUTE OF TECHNOLOGY AND SCIENCE

(UGC-Autonomous)

Accredited by NAAC-'A' Grade, Approved by AICTE, New Delhi.

SERB sponsored Two Days National Seminar

on

IoT and Machine Learning Based

Smart Grid Technology For Future Energy Management

Azadi Ka Amrit Mahotsav

INSTITUTION'S INNOVATION COUNCIL (Ministry of Education Initiative)

Certificate of Participation

This is to certify that Mr./Ms./Mrs./Dr. **Prasanna Pasunari**

from **TKR college of Engineering and Technology** has participated in the "**IoT AND MACHINE LEARNING BASED SMART GRID TECHNOLOGY FOR FUTURE ENERGY MANAGEMENT**". TWO-DAYS National Seminar Event Organized by **SCIENCE AND ENGINEERING RESEARCH BOARD , INDIA** along with **HOLY MARY INSTITUTE OF TECHNOLOGY AND SCIENCE**, Bogaram(V),Keesara(M),Medchal Dist., Hyderabad, Telangana, . The event is held on **28th & 29th JUNE,2024**.

Dr. G. Venkatakoti Reddy CO-Convenor HITS	Dr. M. Saravanan Convenor HITS	Dr. J.B.V.Subrahmanyam Principal HITS

HEAD
Dept. of Computer Science & Engineering
T.K.R. College of Engineering & Technology
Meerpet, Hyderabad-500 097.

PRINCIPAL
TKR College of Engineering & Technology
(AUTONOMOUS)
Medbowli, Meerpet, Hyderabad- 500097.

HOLY MARY INSTITUTE OF TECHNOLOGY AND SCIENCE

(UGC-Autonomous)

Accredited by NAAC-'A' Grade, Approved by AICTE, New Delhi.

SERB sponsored Two Days National Seminar

on

IoT and Machine Learning Based

Smart Grid Technology For Future Energy Management

Certificate of Participation

This is to certify that Mr./Ms./Mrs./Dr. **Anantha Lakshmi Gali**

from **TKRCET** has participated in the "**IoT AND MACHINE LEARNING BASED SMART GRID TECHNOLOGY FOR FUTURE ENERGY MANAGEMENT**". TWO-DAYS National Seminar Event Organized by **SCIENCE AND ENGINEERING RESEARCH BOARD , INDIA** along with HOLY MARY INSTITUTE OF TECHNOLOGY AND SCIENCE, Bogaram(V),Keesara(M),Medchal Dist., Hyderabad, Telangana, . The event is held on **28th & 29th JUNE,2024.**

Dr. G. Venkatakoti Reddy
CO-Convenor
HITS

Dr. M. Saravanan
Convenor
HITS

Dr. J.B.V.Subrahmanyam
Principal
HITS

Dr. A. SURESH RAO
HEAD OF THE DEPARTMENT
Dept. of Computer Science & Engineering
T.K.R. College of Engineering & Technology
Meerpet, Hyderabad-500 097.

PRINCIPAL
TKR College of Engineering & Technology
(AUTONOMOUS)
Medbowli, Meerpet, Hyderabad- 500097.

criteria: 3.4.4

About the Authors

Dr.Nidavanuru Srinivasa Rao working as Associate Professor of Department of Computer Science and Engineering, Narashima Reddy Engineering College, Secunderabad, Telangana, India. He received his B.Tech degree from JNTU Hyderabad in 2008. He received his M.Tech (CSE) from Acharya Nagarjuna University, Guntur, Andhra Pradesh in 2012 & he received his Ph.D (CSE) from Acharya Nagarjuna University, Guntur, Andhra Pradesh in 2020. He published 15 papers in International Journal and 14 papers in International Conference. He published 8 patents. He wrote one book on "Fundamentals of Data Science" in 2021 and Python Programming 2022. He has 14 years of Teaching Experience. He is a Life Member of Society for Learning.

Mrs.Vattepu Pravalika Working as an Assistant Professor (AI&ML) in Department of Computer Science Engineering in TKR College of Engineering and Technology. She received her Bachelor of Technology in Computer Science Engineering from Mina institute of Engg & Technology for Women, JNTUH University. She received her Master of Technology from Swami Ramananda Thirtha Institute of Technology & Science, JNTUH University. She Published 5 Papers in International Journals. She has 05 years of Experience in teaching. Her areas of interest are Digital Image Processing, Internet of Things and Cryptography, Machine Learning etc.

Mrs.Netravathi Sawale Working as a assistant professor in AIML department in Guru Nanak Dev Engineering College Bidar. She received her Bachelor of Engineering in Computer Science Engineering from Guru Nanak Dev Engineering College Bidar. She received her Master of Technology from Khaja Bandanawaz College of Engineering Gulbarga. She published 3 papers in international journals. She has 7 years of experience in teaching. Her area of interest are data science, cloud computing, cryptography & network security.

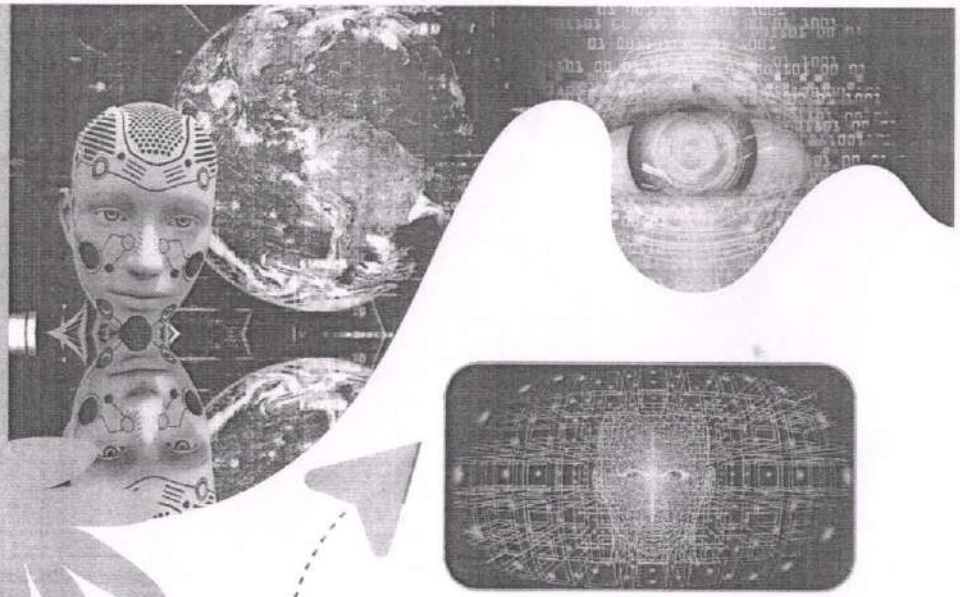
Mr.K.Ravindra Reddy Working as an Assistant Professor (Adhoc) in Department of Electronics and Communication Engineering, JNTUA College of Engineering Pulivendula. He received his Bachelor of Technology in Electronics and Communication Engineering from GATES Institute of Technology, Gooty, Anantapur, JNTU University. He received his Master of Technology from Rajiv Gandhi Memorial College of Engineering and Technology, Nandyal, JNTUA University. He is pursuing Ph.D. in Department of Electronics and Communication Engineering in Vels Institute of Science, Technology & Advanced Studies (VISTAS), Chennai. He Published 20 Papers in International Journals, and 10 Conference Papers. He has 13 years of Experience in teaching. His areas of interest are Digital Image Processing, Network Security and Cryptography, Signal Processing etc.

ICAP PUBLISHERS
INDO-CONTINENTAL ACADEMIC PUBLISHERS

INDO-CONTINENTAL ACADEMIC PUBLISHERS

ISBN 978-81-967589-6-7
9 788196 758967

VISUAL JOURNEY INTO IMAGE PROCESSING
Dr. N. Srinivasa Rao | Mrs. V Pravalika
Mrs. Netravati Sawale | Mr. K. Ravindra Reddy



Visual Journey into Image Processing

Dr. N. Srinivasa Rao | Mrs. V Pravalika
Mrs. Netravati Sawale | Mr. K. Ravindra Reddy

TKR COLLEGE OF ENGINEERING & TECHNOLOGY

AUTONOMOUS, ACCREDITED BY NBA AND NAAC WITH 'A+' GRADE

MEDBOWLI, MEERPET, BALAPUR, HYDERABAD-500 097.

CERTIFICATE

This is to certify that Dr / Mr / Ms / Mrs PRASHAMSA . P

from TKRCET Department of CSE

has participated in the one day workshop on *"Research Inclination towards NIRF"* conducted on *26th June 2024* and Organized by Research & Development Innovation Cell TKR CET.

Dr. B. Rajini Kanth
Co-ordinator
TKRCET - NIRF

Dr. A. SURESH RAO
HEAD OF THE DEPARTMENT
Dept. of Computer Science & Engineering
T.K.R. College of Engineering & Technology
Medbowli, Hyderabad-500 097.

Dr. D.V. Ravishankar
Principal

Pantech e Learning
DIGITAL LEARNING SIMPLIFIED
www.pantechelearning.com

CERTIFICATE

OF PARTICIPATION

THIS IS TO CERTIFY THAT

P.PRASHAMSA

TKRCET

has successfully participated and completed the 1 Day Workshop on **Artificial Intelligence and Machine Learning** organized by Department of Computer Science & Information Technology, **Janardan Rai Nagar Rajasthan Vidyapeeth** in association with **PANTECH E LEARNING PVT LTD**.

SENTHIL KUMAR M.R
DIRECTOR
PANTECH E LEARNING PVT LTD

Prof. S.S.
Sarangdevot
Vice Chancellor

Dr. Chandresh Kumar
Chhatlani
Convener

Dr. A. SURESH RAO
HEAD OF THE DEPARTMENT
Dept. of Computer Science & Engineering
T.K.R. College of Engineering & Technology
Meerpet, Hyderabad-500 097.

PRINCIPAL
TKR College of Engineering & Technology
(AUTONOMOUS)
Medbowli, Meerpet, Hyderabad- 500097

Cert No: PEL-JRNRV-AIML-31

19-06-2024
Date

TKR COLLEGE OF ENGINEERING & TECHNOLOGY

AUTONOMOUS, ACCREDITED BY NBA AND NAAC WITH 'A+' GRADE

MEDBOWLI, MEERPET, BALAPUR, HYDERABAD-500 097.

CERTIFICATE

This is to certify that Dr / Mr / Ms / Mrs G. JYOTHI

from TKRCET Department of CSE

has participated in the one day workshop on *"Research Inclination towards NIRF"* conducted on *26th June 2024* and Organized by Research & Development Innovation Cell TKR CET.

Dr. B. Rajini Kanth
Co-ordinator
TKRCET - NIRF

HEAD OF THE DEPARTMENT
Dept. of Computer Science & Engineering
T.K.R. College of Engineering & Technology
Hyderabad-500 097.

Dr. D.V. Ravishankar
Principal

CERTIFICATE OF PARTICIPATION

This is to certify that

K Naga Maha Lakshmi

Assistant Professor, CSE Department

has participated in the **" Workshop on Managing Professional Research Profiles for Faculty Members & Research Scholars "** organized by the Department of Research & Publications, A2Z EduLearningHub LLP, on 2nd & 3rd September 2024.

Director
A2Z EduLearningHub LLP, India

A2Z EDULEARNINGHUB LLP
PIN:685 595
UDUMBANNOOR

www.edulearninghub.com

Venue: Online
RF2409Q13

DR. A. SURESH RAO
HEAD OF THE DEPARTMENT
Dept. of Computer Science & Engineering
T.K.R. College of Engineering & Technology
Meerpet, Hyderabad-500 097.

PRINCIPAL
TKR College of Engineering & Technology
(AUTONOMOUS)
Medbowli, Meerpet, Hyderabad- 500097.

MTT-S MHz to THz Community | IEEE VIT-AP MTT SBC

VIT-AP UNIVERSITY
Apply Knowledge. Improve Life!®

IEEE VIT-AP STUDENT BRANCH

CERTIFICATE OF PARTICIPATION

This is to certify that

P Venkata Kishan Rao

TKR COLLEGE OF ENGINEERING AND TECHNOLOGY

has successfully participated in the **"4th One-Week International Workshop on Technical Writing using LaTeX (Online)".** The Workshop is organized by the School of Electronics Engineering (SENSE) and Technically Co-Sponsor by VIT-AP IEEE SB and MTT SBC, at VIT-AP University, Amaravati, India during

30th Mar- 5th Apr, 2024.

Dr. Rajeev Sharma
Programme Co-ordinator

Dr. Umakanta Nanda
Dean, SENSE
VIT-AP University

Dr. Ravindra Dhuli
Dean, Academic Research
VIT-AP University

A. SURESH RAO
HEAD OF THE DEPARTMENT
Electronics & Engineering

PRINCIPAL

Artificial Intelligence Medical & Engineering Researchers Society

CERTIFICATE OF PARTICIPATION

This is to certify that

P Venkata Kishan Rao

Has participated in the first workshop of the series, titled "Artificial Intelligence Workshop," held on April 19-20, 2024. This intensive workshop covered a broad range of topics designed to enhance knowledge and practical skills in the field of artificial intelligence. It was organized by the Artificial Intelligence Medical & Engineering Researchers Society. We look forward to P Venkata Kishan Rao's continued participation in the upccming workshops in this series.

Topics Covered:

• Generative AI	• Visual Question Answering
• Document Questions Answering	• Exploration and Application of Various Hugging Face Models
• Text Generation Models	• Advanced Prompting Techniques
• Image and Video Generation	• Summarization Tasks
• Using Pretrained Models like Llama2,GPTNeoX	• Fine-tuning Techniques for Llama2
• Exploring Datasets for AI Applications	• Exploring CNN Algorithms

We commend the participation and engagement demonstrated and wish continued success in future endeavors in artificial intelligence and related fields.

Certificate ID: AIMERS-WS01-124

Dr. A. SURESH RAO
HEAD OF THE DEPARTMENT
Dept. of Computer Science & Engineering

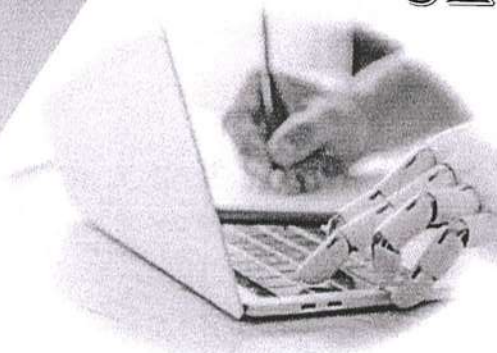
PRINCIPAL

D. SaiSatish, President, AIMER Society

VARDHAMAN COLLEGE OF ENGINEERING, HYDERABAD

(AUTONOMOUS)
Affiliated to JNTUH, Approved by AICTE,
Accredited by NAAC with A++ Grade, and ISO 9001:2015 Certified
(JNTUH College Code : 88)

CERTIFICATE OF PARTICIPATION



Is proudly given to

P VENKATA KISHAN RAO

from Tkr college of engineering and technology, Dept. of CSE, Hyderabad in recognition of outstanding dedication, extraordinary proficiency, and an unwavering participation on a 3 - Day National Level Workshop on **"AI - Augmented Scientific Writing and Publishing"** organized by Dept. of Information Technology at Vardhaman College of Engineering, held during 14th February 2024 to 16th February 2024.

Dr. K. S. SOWMIYA RANI
DAAD Fellow(Germany)
Editor, Editage (Coctus Comm`s)

Dr. A. SURESH RAO
HEAD OF THE DEPARTMENT
Dept. of Computer Science & Engineering
T.K.R. College of Engineering & Technology
Meerpet, Hyderabad-500 097

Dr. G SURYANARAYANA
HOD, IT

Dr. J V R RAVINDRA
PRINCIPAL

PRINCIPAL
TKR College of Engineering & Technology
(AUTONOMOUS)
Medbowli, Meerpet, Hyderabad- 500097.

TKR COLLEGE OF ENGINEERING & TECHNOLOGY

AUTONOMOUS, ACCREDITED BY NBA AND NAAC WITH 'A+' GRADE

MEDBOWLI, MEERPET, BALAPUR, HYDERABAD-500 097.

CERTIFICATE

This is to certify that Dr / Mr / Ms / Mrs B. NAGA NANDINI

from TKRCET Department of CSE

as participated in the one day workshop on *"Research Inclination towards NIRF"* conduct

5th June 2024 and Organized by Research & Development Innovation Cell TKR CET.

B. Rajini Kanth
Co-ordinator
TKRCET - NIRF

Dr. A. SURESH RAO
HEAD OF THE DEPARTMENT
Dept. of Computer Science & Engineering
T.K.R. College of Engineering & Technology
Meerpet, Hyderabad-500 097.

Dr. D.V. Ravi
Principa

TKR COLLEGE OF ENGINEERING & TECHNOLOGY

AUTONOMOUS, ACCREDITED BY NBA AND NAAC WITH 'A+' GRADE

MEDBOWLI, MEERPET, BALAPUR, HYDERABAD-500 097.

CERTIFICATE

This is to certify that ~~Dr / Mr~~ / Ms / ~~Mrs~~ D VV DEEPTHI

from TKRCET Department of CSE

has participated in the one day workshop on *"Research Inclination towards NIRF"* conducted on *26th June 2024* and Organized by Research & Development Innovation Cell TKR CET.

Dr. B. Rajim Kanth
Co-ordinator
TKRCET - NIRF

Dr. A. SURESH RAO
HEAD OF THE DEPARTMENT
Dept. of Computer Science & Engineering
T.K.R. College of Engineering & Technology
Meerpet, Hyderabad-500 097.

PRINCIPAL
TKR College of Engineering & Technology
(AUTONOMOUS)
Medbowli, Meerpet, Hyderabad- 500097.

Dr. D.V. Ravishankar
Principal

Simplified Design of IMC-Tuned PID Controller for Integrating Process Based on Maximum Sensitivity

| Conference paper | First Online: 27 September 2022
| pp 81–93 | Cite this conference paper

Proceedings of International Conference on Communication and Computational Technologies

P. V. Gopi Krishna Rao ✉, R. Hanuma Naik, M. Anil Kumar, M. Mahesh, M. V. Rajasekhar & M. Venkata Sudhakar

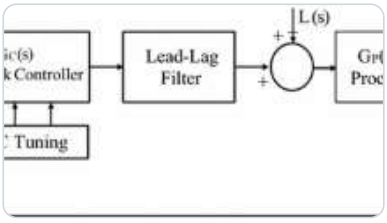
Part of the book series: Algorithms for Intelligent Systems ((AIS))

Abstract

The design of proportional integral derivative (PID) controller based on internal model control (IMC) principle with a new form of filter is presented to realize the controller to achieve satisfy regulatory behavior, servo behavior, robustness and input constraints handling capacity. The technique is evaluated on the integrating process with time delay, incorporating a third order filter to realize the controller. To demonstrate the efficacy of IMC technique to tune PID-type controller, a laboratory benchtop liquid level process setup is considered for implementation. The outcomes of the experiments carried out with design of controller for maximum sensitivity $M_S = 1.5$ for uniform robustness rank for comparison of the proposed technique with other techniques and incorporation of model mismatch

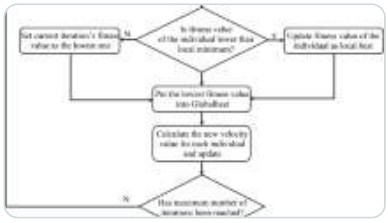
of 20% contributed <1% variation in the performance indicators, rendering the adoption of the proposed technique.

Similar content being viewed by others



Robust Design of PID Controller Using IMC Technique for Integrating Process Based on Maximum Sensitivity

Analytical Design of IMC-Based PID Controller for Non-minimum Phase Process with Time Delay



Optimal PI–PD Controller Design for Pure Integrating Processes with Time Delay

References

1. Shamsuzzoha M, Lee M (2008) Analytical design of enhanced PID filter controller for integrating and first order unstable processes with time delay. Chem Eng Sci 63:2717–2731

Article Google Scholar

2. Panyam Vuppu GKR, Makam Venkata S, Kodati S (2015) Robust design of PID controller using IMC technique for integrating process based on maximum sensitivity. J Control Autom Electric Syst 26(5):466–475

Article Google Scholar

3. Chien IL, Fruehauf PS (1990) Consider IMC tuning to improve performance. Chem Eng Prog 86:33–41

Google Scholar

4. Vanavil B, Anusha AVNL, Perumalsamy M, Rao AS (2014) Enhanced IMC-PID controller design with lead-lag filter for unstable and integrating processes with time delay. Chem Eng Commun 201(11):1468–1496

Article Google Scholar

5. Lee, M., Shamsuzzoha, M., Vu, T. N. L., (2008, October,). IMC-PID approach: An effective way to get an analytical design of robust PID controller, International Conference on Control Automation and Systems, Seoul, Korea, 2861 – 2866.

Google Scholar

6. Pai NS, Chang SC, Huang CT (2010) Tuning PI/PID controllers for integrating processes with deadtime and inverse response by simple calculations. J Process Control 20(6):726–733

Article Google Scholar

7. Eris O, Kurtulan S (2011) A new PI tuning rule for first order plus dead-time systems. IEEE Africon 11:1–4

Google Scholar

8. Rao PVGK, Subramanyam MV, Satyaprasad K (2013) Model based Tuning of PID Controller. J Control Instrument 4(1):16–22

Google Scholar

9. Desborough, L. D., Miller, R.M. (2002, January). Increasing customer value of industrial control performance monitoring—Honeywell's experience. Chemical Process Control – VI, AIChE Symposium Series No. 326. 98, Tuscon, Arizona, USA. 153–186.

Google Scholar

10. Alcántara S, Vilanova R, Pedret C (2013) PID control in terms of robustness/performance and servo/regulator trade-offs: a unifying approach to balanced auto tuning. J Process Control 23(4):527–542

Article Google Scholar

11. Shamsuzzoha, M. (2014). A unified approach of PID controller tuning for time delay processes, American Control Conference (ACC), 4865-4870, doi: https://doi.org/10.1109/ACC.2014.6859067

12. Saxena S, Hote YV (2012) Advances in internal model control technique: a review and future prospects. IETE Tech Rev 29:461–472

Article Google Scholar

13. Morari M, Zafiriou E (1989) Robust process control. Prentice Hall, Englewood Cliffs, NJ

MATH Google Scholar

14. Shamsuzzoha M, Lee M (2008) Design of advanced pid controller for enhanced disturbance rejection of second-order processes with time delay. AIChE J 54(6):1526–1536

Article Google Scholar

15. Shamsuzzoha M, Lee M (2007) IMC-PID controller design for improved disturbance rejection of time-delayed processes. Ind Eng Chem Res 46(7):2077–2091

Article Google Scholar

16. Rivera DE, Morari M, Skogestad S (1986) Internal model control. 4. PID controller design. Ind Eng Chem Process Des Dev 25:252–265

Article Google Scholar

17. Horn IG, Arulandu JR, Christopher JG, VanAntwerp JG, Braatz RD (1996) Improved filter design in internal model control. Ind Eng Chem Res 35:3437–3441

Article Google Scholar

18. Gopi Krishna Rao PV, Subramanyam MV, Satyaprasad K (2014) Design of IMC-PID controller with improved filter for disturbance rejection. Syst Sci Control Eng 2(1):583–592

Article Google Scholar

19. Lee Y, Lee J, Park S (2000) PID controller tuning for integrating and unstable processes with time delay. Chem Eng Sci 55(17):3481–3493

Article Google Scholar

20. Tan W, Marquez HJ, Chen T (2003) IMC design for unstable processes with time delays. J Process Control 13(3):203–213

Article Google Scholar

21. Arbogast JE, Cooper DJ (2007) Extension of IMC tuning correlations for non-self regulating (integrating) processes. ISA Trans 46(3):303–311

Article Google Scholar

22. Chia TL, Lefkowitz I (2010) Internal model-based control for integrating processes. ISA Trans 49(4):519–527

Article Google Scholar

23. Zhao ZC, Liu ZY, Zhang JG (2011) IMC-PID tuning method based on sensitivity specification for process with time-delay. J Cent South Univ Technol 18:1153–1160

Article Google Scholar

24. Zhao, Z., Liu, Z., & Zhang, J. (2011). IMC-PID robust tuning method for integrated process with time-delay. Journal of Huazhong University of Science and Technology (Nature Science Edition), 39(12).

Google Scholar

25. Panda RC, Vijayan V, Sujatha V, Deepa P, Manamali D, Mandal AB (2011) Parameter estimation of integrating and time delay processes using single relay feedback test. ISA Trans 50(4):529–537

Article Google Scholar

26. Liu, T., Gao, F. (2011). Enhanced IMC design of load disturbance rejection for integrating and unstable processes with slow dynamics. ISA transactions,50(2): 239–248.

Google Scholar

27. Paul PK, Dey C, Mudi RK (2012) Model based PID controller for integrating process with its real time implementation. Int J Adv Electron Electric Eng 1(2):139–144

Google Scholar

28. Anusha, A. V. N. L., Rao, A. S. (2012). Design and analysis of IMC based PID controller for unstable systems for enhanced closed loop performance. In Proc. IFAC Conf. Advances in PID control (PID'12).

Google Scholar

29. Shamsuzzoha M, Skliar M, Lee M (2012) Design of IMC filter for PID control strategy of open-loop unstable processes with time delay. Asia-Pac J Chem Eng 7(1):93–110

Article Google Scholar

30. Paul, P. K., Dey, C., Mudi, R. K. (2013, August). Design of Fuzzy Based IMC-PID Controller for IPDT Process. IEEE International Symposium on Computational and Business Intelligence (ISCBI), 111–114.

Google Scholar

31. Jin QB, Liu Q (2014) Analytical IMC-PID design in terms of performance/robustness trade-off for integrating processes: from 2-Dof to 1-Dof. J Process Control 24(3):22–32

Article MathSciNet Google Scholar

32. Simhachalam, D., & Mudi, R. K. (2014, January). A Self-tuning Fuzzy PI Controller for Pure Integrating Processes. Proceedings of the International Conference on Frontiers of Intelligent Computing: Theory and Applications (FICTA), Springer International Publishing, 25–32.

Google Scholar

33. Seborg, DE., Edgar, TF., & Mellichamp, DA.(2004). Process Dynamics and Control, 2nd ed. Wiley, New York.

Google Scholar

34. Lee Y, Park S, Lee M, Brosilow C (1998) PID controller tuning for desired closed-loop responses for SI/SO systems. AIChE J 44:106–115

Article Google Scholar

35. O'Dwyer A (2006) Hand book of PI and PID controller tuning rules, 2nd edn. Imperial College press, London

Book MATH Google Scholar

36. Garcia, C. E., & Morari, M., (1982). Internal Model Controls 1. A Unifying Review and Some New Results. Ind. Eng. Chem. Process Des. Dev., 21, 308.

Google Scholar

37. Gopi Krishna Rao, P V., Subramanyam, M V., & Satyaprasad, K. (2014b). Design of Cascaded IMC-PID Controller with Improved Filter for Disturbance Rejection, International Journal of Applied Science and Engineering, 12(2): 127-141.

Google Scholar

38. Stephanopoulos G (1984) Chemical process control: an introduction to theory and practice. Prentice-Hall Inc., Englewood Cliffs, New Jersey

Google Scholar

39. Liu, T., and Gao, F., (2012). Control of Single-Input-Single- Output (SISO) Processes, Advances in Industrial Control, Springer Link, 978–0–85729–977–2, 243–277.

Google Scholar

40. Shamsuzzoha M (2016) IMC based robust PID controller tuning for disturbance rejection. J Central South Univ 23:581–597

Article Google Scholar

41. Besta CS, Chidambaram M (2018) Improved decentralized controllers for stable systems by imc method. Indian Chem Eng 60(4):418–437

Article Google Scholar

42. Nithya S, Gour AS, Dr N, Sivakumaran NA (2008) Measurement and control of process using soft computing. Instrum Sci Technol 36(2):194–208

Article Google Scholar

43. Process Stations – VLPA 101 technical datasheets, Vimicrosystems, Chennai.

Google Scholar

44. M6221 Data acquiaition card, technical data sheets, National Instrumnets, Austin, Texas.

Google Scholar

45. John Park, Steve Mackay, Practical Data Acquisition for Instrumentation and Control Systems, Newnes an imprint of Elsevier, Burlington, 2003.

Google Scholar

46. Sanjay Gupta, Joseph John, Virtual Instrumentation using LabVIEW, 2nd edition, Tata McGraw-Hill Education, New Delhi, India, 2010.

Google Scholar

Author information

Authors and Affiliations

Rajeev Gandhi Memorial College of Engineering and Technology, Nandyal, India
P. V. Gopi Krishna Rao, R. Hanuma Naik & M. V. Rajasekhar

Santhiram Engineering College, Nandyal, India
M. Anil Kumar

TKR College of Engineering and Technology, Hyderabad, India
M. Mahesh

Lakireddy Bali Reddy College of Engineering, Mylavaram, India
M. Venkata Sudhakar

Corresponding author

Correspondence to P. V. Gopi Krishna Rao .

Editor information

Editors and Affiliations

Christ (Deemed to be University), Bengaluru, Karnataka, India
Sandeep Kumar

Rajasthan Institute of Engineering and Technology, Jaipur, Rajasthan, India
Saroj Hiranwal

Rajasthan Technical University, Kota, Rajasthan, India
S. D. Purohit

School of Computer Science, University of Technology Sydney, Sydney, NSW, Australia
Mukesh Prasad

Rights and permissions

Copyright information

About this paper

Cite this paper

Gopi Krishna Rao, P.V., Hanuma Naik, R., Anil Kumar, M., Mahesh, M., Rajasekhar, M.V., Venkata Sudhakar, M. (2023). Simplified Design of IMC-Tuned PID Controller for Integrating Process Based on Maximum Sensitivity. In: Kumar, S., Hiranwal, S., Purohit, S.D., Prasad, M. (eds) Proceedings of International Conference on Communication and Computational Technologies . Algorithms for Intelligent Systems. Springer, Singapore.
https://doi.org/10.1007/978-981-19-3951-8_7

.RIS .ENW .BIB

DOI
https://doi.org/10.1007/978-981-19-3951-8_7

Published
27 September 2022

Publisher Name
Springer, Singapore

Print ISBN
978-981-19-3950-1

Online ISBN
978-981-19-3951-8

eBook Packages
Intelligent Technologies and Robotics

Intelligent Technologies and Robotics (R0)

Publish with us

Policies and ethics