

In the Name of God

---

---

## IRANIAN JOURNAL OF FUZZY SYSTEMS

---

---

### HONORARY EDITOR-IN-CHIEF

**M. Mashinchi**, *Shahid Bahonar University of Kerman, Kerman, Iran*

### EDITOR-IN-CHIEF

**M. M. Zahedi**, *Graduate University of Advanced Technology, Kerman, Iran*

### MANAGING EDITOR

**R. A. Borzooei**, *Shahid Beheshti University, Tehran, Iran*

### EDITORIAL BOARD

<b>S. Abbasbandy</b> , <i>Ghazvin, Iran</i>	<b>J. N. Mordeson</b> , <i>Omaha, USA</i>
<b>M. Baczynski</b> , <i>Katowice, Poland</i>	<b>W. Pedrycz</b> , <i>Alberta, Canada</i>
<b>R. A. Borzooei</b> , <i>Tehran, Iran</i>	<b>F. G. Shi</b> , <i>Beijing, China</i>
<b>A. Daneshgar</b> , <i>Tehran, Iran</i>	<b>S. M. Taheri</b> , <i>Tehran, Iran</i>
<b>A. Di Nola</b> , <i>Salerno, Italy</i>	<b>J. L. Verdegay</b> , <i>Granada, Spain</i>
<b>E. Eslami</b> , <i>Kerman, Iran</i>	<b>R. Viertl</b> , <i>Wien, Austria</i>
<b>G. Jaeger</b> , <i>Stralsund, Germany</i>	<b>Z. Xu</b> , <i>Sichuan, China</i>
<b>M. Mashinchi</b> , <i>Kerman, Iran</i>	<b>M. M. Zahedi</b> , <i>Kerman, Iran</i>
<b>R. Mesiar</b> , <i>Bratislava, Slovakia</i>	

### ADVISORY BOARD

<b>R. A. Aliev</b> , <i>(Baku, Azarbaijan)</i>	<b>Y. B. Jun</b> , <i>(Chinju, South Korea)</i>	<b>H. Prade</b> , <i>(Toulouse, France)</i>
<b>T. Allahviranloo</b> , <i>(Istanbul, Turkey)</i>	<b>M. Kalina</b> , <i>(Bratislava, Slovakia)</i>	<b>A. Ralescu</b> , <i>(Cincinnati, USA)</i>
<b>M. Amini</b> , <i>(Mashhad, Iran)</i>	<b>S. Katebi</b> , <i>(Shiraz, Iran)</i>	<b>D. Ralescu</b> , <i>(Cincinnati, USA)</i>
<b>A. Borumand Saeid</b> , <i>(Kerman, Iran)</i>	<b>I. Kaya</b> , <i>(Istanbul, Turkey)</i>	<b>N. Sadati</b> , <i>(Tehran, Iran)</i>
<b>J. J. Buckley</b> , <i>(Birmingham, USA)</i>	<b>L. T. Koczy</b> , <i>(Budapest, Hungary)</i>	<b>R. Saadati</b> , <i>(Tehran, Iran)</i>
<b>P. Corsini</b> , <i>(Udine, Italy)</i>	<b>A. Memariani</b> , <i>(Tehran, Iran)</i>	<b>A. Sostak</b> , <i>(Riga, Latvia)</i>
<b>B. De Baets</b> , <i>(Gent, Belgium)</i>	<b>H. Mishmast Nehi</b> , <i>(Zahedan, Iran)</i>	<b>M. Sugeno</b> , <i>(Kyoto, Japan)</i>
<b>D. Dubois</b> , <i>(Toulouse, France)</i>	<b>M. Mukaidono</b> , <i>(Kawasaki, Japan)</i>	<b>M. Teshnehlab</b> , <i>(Tehran, Iran)</i>
<b>M. Eftekhari</b> , <i>(Kerman, Iran)</i>	<b>H. Nezamabadi-pour</b> , <i>(Kerman, Iran)</i>	<b>B. L. Turkmen</b> , <i>(Toronto, Canada)</i>
<b>S. C. Fang</b> , <i>(Raleigh, North Carolina)</i>	<b>N. R. Pal</b> , <i>(Calcutta, India)</i>	<b>A. Vahidian Kamyad</b> , <i>(Mashhad, Iran)</i>
<b>M. Jamshidi</b> , <i>(Texas, USA)</i>	<b>I. Perfiljeva</b> , <i>(Ostrava, Czech)</i>	<b>M. A. Yaghoobi</b> , <i>(Kerman, Iran)</i>

### SUBSCRIPTION RATE

Iranian Journal of Fuzzy Systems (IJFS) is published two-monthly by the University of Sistan and Baluchestan. Annual subscription rates (including packing and postage) are as follows: for university departments, libraries, industrial and other multiple-reader institutions in Iran 900,000 Rials, in other countries 40 EURO; for individuals in Iran 700,000 Rials, in other countries 30 EURO. Reprints of papers are available for 150,000 Rials per copy in Iran and 2 EURO per copy elsewhere (Including packing and postage). For more information, please visit the website of the journal.

### Journal Address

**Iranian Journal of Fuzzy Systems**  
University of Sistan and Baluchestan, P.O. Box 98135-987  
Zahedan, Iran.  
Tel & Fax: +98-54-33431060  
E-mail: [ijfs@usb.ac.ir](mailto:ijfs@usb.ac.ir)  
Homepage: <http://ijfs.usb.ac.ir>

# IRANIAN JOURNAL OF FUZZY SYSTEMS

Volume 18 Number 6 December 2021

IJFS

University of Sistan and Baluchestan, Zahedan, Iran.

<i>A. Stupňanová, Y. Su and R. Mesiar</i> End-point linear functions	1
<i>Y. Liu, M. Liu and X. Xu</i> Adaptive control design for fixed-time synchronization of fuzzy stochastic cellular neural networks with discrete and distributed delay	13
<i>G. Wang and Y. Xu</i> Calculation of centroid of high dimensional fuzzy number and application	29
<i>S. N. Hosseini and R. Amini</i> Structural topology in a category	45
<i>Y. Zhong and A. Šostak</i> A new definition of fuzzy $k$ -pseudo metric and its induced fuzzifying structures	55
<i>S. Shreevastava, S. Singh, A. K. Tiwari and T. Som</i> Different classes ratio and Laplace summation operator based intuitionistic fuzzy rough attribute selection	67
<i>S. Hasanzadeh, S. M. Fakhrahmad and M. Taheri</i> A fuzzy approach to review-based recommendation: Design and optimization of a fuzzy classification scheme based on implicit features of textual reviews	83
<i>G. Işık and İ. Kaya</i> Design and analysis of acceptance sampling plans based on intuitionistic fuzzy linguistic terms	101
<i>Y. H. Liao</i> A normalized distribution mechanism under multi-criteria situations and fuzzy behavior	119
<i>R. Khalil Amirabadi, O. S. Fard and A. Mansoori</i> A novel fuzzy sliding mode control approach for chaotic systems	133
<i>R. Beigmohamadi and A. Khastan</i> Interval discrete fractional calculus and its application to interval fractional difference equations	151
<i>Y. Liu, W. X. Diao, J. Yang and J. H. Yi</i> A visual social network group consensus approach with minimum adjustment based on Pythagorean fuzzy set	167
<i>G. Soyulu and M. E. Aslan</i> Fuzzy arithmetic with product t-norm	185
<i>Persian Translation of Abstract</i>	199

## ACKNOWLEDGMENTS

IJFS would like to thank the following experts for their invaluable help as Area Editors and Referees in 2020. Their advice and support are greatly appreciated.

### A: Area Editors

**S. Abbasbandy**

*Imam Khomeini International  
University, Ghazvin, Iran*

**G. Jäger Rhodes**

*University, Grahamstown,  
South Africa*

**I. Perfiljeva**

*University of Ostrava, Institute for  
Research and Applications of  
Fuzzy Modeling, Czech Republic*

**T. Allahviranloo**

*Faculty of engineering and natural  
science, Bahcesehir university,  
Istanbul, Turkey.*

**M. Kalina**

*Faculty of Civil Engineering,  
Slovak University of Technology,  
Bratislava, Slovakia*

**R. Saadati**

*University of Science and  
Technology, Department of  
Mathematics, Tehran, Iran*

**M. Amini**

*Department of Statistics, Faculty  
of Mathematical Science,  
Ferdowsi University of Mashhad*

**I. Kaya**

*Yıldız Technical University  
Department of Industrial  
Engineering, Beşiktaş-Istanbul*

**F. G. Shi**

*Beijing Institute of Technology,  
Beijing, China*

**M. Baczynski**

*Institute of Mathematics,  
University of Silesia in Katowice,  
Katowice, Poland*

**F. Kouchakinejad**

*Shahid Bahonar University of  
Kerman, Kerman, Iran*

**S. M. Taheri**

*University of Tehran, Tehran, Iran*

**A. Borumand Saeid**

*Shahid Bahonar University of  
Kerman, Kerman, Iran*

**M. Mashinchi**

*Shahid Bahonar University of  
Kerman, Kerman, Iran*

**M. Teshnehlab**

*KN Toosi University of  
Technology, Tehran, Iran*

**R. A. Borzooei**

*Shahid Beheshti University, Tehran,  
Iran*

**R. Mesiar**

*University in Bratislava, Slovakia*

**R. Viertl**

*Vienna University of Technology,  
Vienna, Austria*

**M. Eftekhari**

*Shahid Bahonar University of  
Kerman, Kerman, Iran*

**H. Mishmast Nehi**

*University of Sistan and  
Baluchestan, Iran*

**Z. Xu**

*Academician of IASCYS, Sichuan  
University, China*

**R. Ezzati**

*Islamic Azad University, Karaj  
Branch, Karaj, Iran*

**G. Jäger Rhodes**

*University, Grahamstown, South  
Africa*

**M. A. Yaghoobi**

*Shahid Bahonar University of  
Kerman, Kerman, Iran*

**H. Hassanpour**

*University of Birjand, Birjand,  
Khorasan, Iran*

**H. Nezamabadipour**

*Shahid Bahonar University of  
Kerman, Kerman, Iran*

## B: Referees

**M. Aaly Kologani**

Shahid Beheshti university, Tehran,  
Iran

**O. A. E. Abu Arqub**

l-Balqa' Applied University, Salt,  
Jordan

**A. Adil**

Dokuz Eylul University, Izmir,  
Turkey

**H. Agahi**

Babol Noshirvani University,  
Babol, Iran

**M. Ahmadieh Khanesar**

University of Nottingham,  
Nottingham, England

**H. Ahmadzade**

University of Sistan and  
Baluchestan, Zahedan, Iran

**M. Akram**

University of the Punjab, Lahore,  
Pakistan

**J. Alcantud**

University of Salamanca,  
Salamanca, Spain

**R. A. Aliev**

Azərbaycan Dövlət Neft və Sənaye  
Universiteti, Baku, Azerbaijan

**T. Allahviranloo**

Bahcesehir university, Istanbul,  
Turkey

**M. Amirkhan**

Islamic Azad University, Tehran,  
Iran

**B. Anjana**

Victoria institution (college),  
Kolkata, India

**J. Antoch**

Charles university, Prague, Czech  
Republic

**E. Baloui Jamkhaneh**

Islamic Azad University,  
Qaemshahr, Iran

**L. E. C. Barrón**

Tecnológico de Monterrey, Private  
university in Monterrey, Mexico

**M. A. Basaran**

Alanya Alaaddin Keykubat  
University, Alanya, Turkey

**T. Bentrchia**

University of Batna, 05000 Batna,  
Algeria

**A. Borumand Saeid**

Shahid Bahonar University of  
Kerman, Kerman, Iran

**R. A. Borzooei**

Shahid Beheshti University, Tehran,  
Iran

**B. Y. Cao**

Guangzhou University, Guangzhou,  
China

**M. Chehlabi**

Islamic Azad University,  
Savadkooh, Iran

**N. Chukhrova**

University of Hamburg, Hamburg,  
Germany

**R. Chutia**

Cotton Collage, Guwhati, Assam,  
India

**Y. Deng**

University in Chengdu, Chengdu,  
China

**M. B. Dowlatshahi**

Lorestan University,  
Khorramabad, Iran

**K. Dyczkowski**

Adam Mickiewicz University,  
Poznań, Poland

**U. Ertuğrul**

University of Trabzon, Turkey

**F. Forouzes**

University of Bam, Bam, Iran

**J. Gao**

University of China Qingdao  
266100, China

**Z. Gong**

Northwest Normal University,  
China

**M. GUL**

Munzur University, Tunceli, Turkey

**A. Gupta**

Delhi Technological University,  
Delhi-India

**T. Hajjari**

Ferdowsi University of Mashhad,  
Mashhad, Iran

**F. Hashemi**

University of Pretoria,  
Pretoria, South Africa

**G. H. Heydari**

Shahid Bahonar University of  
Kerman, Kerman, Iran

**B. Huang**

Nanjing Audit University, Nanjing,  
China

**O. Hutník**

Pavol Jozef Šafárik University in  
Košice, Slovakia

**P. Jafari**

University of Sistan and  
Baluchestan, Zahedan, Iran

**D. K. Jana**

Haldia Institute of Technology,  
Haldia, India

**J. Antucheviciene**

*Ilnius Gediminas Technical  
University, Dvilnius, Lithuania*

**K. Atanassov**

*Bulgarian Academy, Sofia,  
Bulgaria*

**L. Jin**

*Nanjing Normal University,  
Nanjing, China*

**W. Jin Rong**

*Guizhou University, Guiyang,  
Guizhou, P. R. China*

**W. JR**

*Guizhou University, Guiyang, P.  
R. China*

**M. Kalina**

*Slovak University of Technology,  
Bratislava, Slovakia*

**H. Ke**

*Tongji University, Shanghai, P. R.  
China*

**M. A. Khanesar**

*University of Nottingham,  
Nottingham, England*

**A. Khastan**

*Institute for Advanced Studies in  
Basic Sciences, Zanjan, Iran*

**W. W. Koczkodaj**

*Laurentian University, Sudbury,  
Canada*

**L. T. KÓCZY**

*Budapest University of Technology  
and Economics, Budapest, Hungary*

**S. Lazona**

*University of Seville, Seville, Spain*

**L. Li**

*Beijing University, Beijing, China*

**H. Liao**

*Sichuan University, Chengdu,  
China*

**A.S. Edalatpanah**

*University of Guilan, Rasht, Iran*

**M. Eftekhari**

*Shahid Bahonar University of  
Kerman, Iran*

**H. W. Liu**

*Shandong University, Jinan, China*

**P. Liu**

*Shandong University, Jinan, China*

**Y. Liu**

*Hebei University, Baoding, China*

**M. Luo**

*China, Jiliang University,  
Hangzhou, China*

**M. Majid**

*Khatam University of Technology,  
Behbahan, Iran*

**S. Majumder**

*Samarjit Kar National Institute of  
Technology, Durgapur, India*

**M. Manthouri**

*Shahed university, Persian Gulf  
Highway, Tehran, Iran*

**A. Mardani**

*University of South Florida (USF)  
Tampa, FL, USA*

**M. Mashinchi**

*Shahid Bahonar University of  
Kerman, Kerman, Iran*

**M.R. Mashinchi**

*Payame-Noor University (PNU),  
Kerman, Iran*

**M. Mazandarani**

*Ferdowsi University of Mashhad,  
Mashhad, Iran*

**R. Mesiar**

*Slovak University, Bratislava,  
Slovakia*

**J. Jian**

*China Three Gorges University,  
Yichang, Hubei, China*

**A. L. Jiménez**

*Universidad de Sevilla, Sevilla,  
Spain*

**M. Mousazadeh**

*University of Tehran, Tehran, Iran*

**A. Nadizadeh**

*University of Ardakan, Ardakan,  
Iran*

**H. Navidi**

*Shahed University, Tehran, Iran*

**L. Nedović**

*University of Novi Sad, Novi Sad,  
Serbia*

**V. H. Ngo**

*Ton Duc Thang University, Ho Chi  
Minh City, Vietnam*

**J. J. Nieto**

*University of Santiago de  
Compostela, Santiago, Spain*

**D. Pamučar**

*Military Academy, Belgrade, Serbia*

**B. Pang**

*Beijin Institute of Technology,  
Beijing, China*

**D. Pei**

*Zhejiang Sci-Tech University,  
Hangzhou, China*

**Z. Petrić**

*Serbian Academy of Sciences and  
Arts, Beograd, Serbia*

**A. Piegat**

*West Pomeranian University  
of Technology, Poland*

**R. E. Precup**

*Politehnica University of  
Timisoara, Timisoara, Romania*

**M. Lin**

*Fujian Normal University,  
Fuzhou, China*

**A. Liu**

*Xidian University, Xi'an, China*

**B. Liu**

*Tsinghua University, Beijing, China*

**N. Rathi**

*College of Engineering Roorkee  
(COER), Roorkee, India*

**S. Rathinasamy**

*Bharathiyar University,  
Coimbatore, India*

**B. Rezaie**

*Babol Noshirvani University of  
Technology, Babol, Iran*

**S. Rezvani**

*Nowshahr, Baharestan Shomali,  
Mazandaran, Iran*

**S. Rivaz**

*Noshirvani Technical University,  
Babol, Iran*

**A. Roldan**

*University of Jaen, Jaén, Spain*

**M. Sadeghi Dastaki**

*Amirkabir University of  
Technology, Tehran, Iran*

**M. Saheli**

*Vali-e-Asr University of Rafsanjan,  
Iran*

**S. Salahshour**

*Bahcesehir University, Istanbul,  
Turkey*

**A. Šeliga**

*Slovak University of Technology,  
Bratislava, Slovakia*

**K. Mis**

*University of Silesia in  
Katowice, Katowice, Poland*

**A. R. Mishra**

*Govt College Jaitwara,  
Satna, MP, India*

**M. Mohammadi**

*Imt-atlantique, Lab-STICC, UBL,  
Brest, France*

**Ch. Shen**

*Nanjing Normal University,  
Nanjing, China*

**F. G. Shi**

*Wenzhou Medical University,  
Wenzhou, PR China*

**Y. Shi**

*Shantou University, Shantou, China*

**A. Singh**

*Awaharlal Nehru Technological  
University Hyderabad, India*

**P. Singh**

*Motilal Nehru National Institute of  
Technology, Allahabad, Uttar Pradesh,  
India*

**A. Sipošova**

*Slovak University of Technology,  
Bratislava, Slovakia*

**I. Stajner-Papuga**

*Faculty of Engineering, University  
of Novi Sad, Serbia*

**M. Štěpnička**

*University of Ostrava, Ostrava,  
Czech Republic*

**A. Stupňanová**

*Slovak University of Technology,  
Bratislava, Slovakia*

**R. Subramaniam**

*Kunsan National University,  
Gunsan, South Korea*

**M. R. Tavakkoli**

*University of Tehran, Tehran, Iran*

**J. Tayyebi**

*Birjand University of Technology,  
Birjand, Iran*

**H. P. Thao**

*Hanoi University of Education,  
Hanoi, Vietnam*

**S. Tomasiello**

*University of Tartu, Tartu, Estonia*

**T. P. Tomy Perdana**

*Universitas Padjadjaran Jl.Raya  
Bandung-Sumedang KM 21,  
Indonesia*

**Sh. Tong**

*University of Technology  
Jinzhou 121001, China*

**M. R. Tavakkoli**

*University of Tehran, Tehran, Iran*

**R. F. Urban**

*Wroclaw University Wroclaw,  
Poland*

**E. Valipour**

*Shahid Bahonar University of  
Kerman, Iran*

**J. Wang**

*Central South University,  
Changsha, China*

**K. Wang**

*Shanghai University, Shanghai,  
China*

**G. Wei**

*Sichuan Normal University,  
Chengdu, China*

**W.M. Weijun Ma**

*Ningxia University, Yinchuan,  
Ningxia, China*

**C. Sempi**

*Università del Salento, 73100,  
Lecce, Italy*

**S. Sessa**

*Dipartimento di Architettura,  
Naples, Italy*

**A. Sheikhi**

*Shahid Bahonar University,  
Kerman, Iran*

**Z. Xu**

*Sichuan University, Chengdu,  
China*

**G. Xunjie**

*Sichuan University, Chengdu  
610064, China*

**T.H. Yan**

*China Jiliang University,  
Hangzhou 310018, China*

**X.P. Yang**

*Hanshan Normal University,  
Chaozhou, China*

**K. Yao**

*University of Chinese Academy of  
Sciences, Beijing, China*

**G. Sun**

*Harbin Institute of Technology,  
Harbin, China*

**W. Sun**

*Harbin Institute of Technology,  
Harbin, PR China*

**W. Yao**

*Hebei University, Baoding, China*

**J. Yu**

*Xinjiang University, Urumqi,  
Xinjiang, China*

**Y. Yue**

*Ocean University of China,  
Qingdao, P.R.China*

**S. Zahiri**

*Dept. of Math. Iqlid, Iqlid, Iran*

**M. Zdimalova**

*Slovak University of Technology  
Bratislava, Slovakia*

**A. Zemankova**

*Institute of mathematics, Slovak  
Academy of Sciences, Bratislava,  
Slovakia*

**M. Wen**

*Beihang University, Beijing  
100191, China*

**X.Y. Xiaohui Yu**

*Beijing Wuzi University, Beijing  
101149, China*

**J. Zhan**

*Hubei University for Nationalities,  
Enshi City, China*

**D. Zhang**

*Changji North Road, Changchun,  
China*

**Q. Zhi-Cheng**

*South China University of  
Technology, Guangzhou, China*

**B. Zhou**

*Tianjin University, Tianjin  
300072, China*

**H. J. Zhou**

*Shaanxi Normal University, Xi'an,  
China*

**D. Zhang**

*Changji North Road, Changchun,  
China*



---

---

# ***IRANIAN JOURNAL OF FUZZY SYSTEMS***

---

---

## **Aims and Scope**

The two-monthly Iranian Journal of Fuzzy Systems (IJFS) aims to provide an international forum for refereed original research works in the theory and applications of fuzzy sets and systems in the areas of foundations, pure mathematics, artificial intelligence, control, robotics, data analysis, data mining, decision making, finance and management, information systems, operations research, pattern recognition and image processing, soft computing and uncertainty modeling.

Manuscripts submitted to the IJFS must be original unpublished works and should not be in consideration for publication elsewhere.

## **Instructions to Authors**

The language of the journal is English. All accepted papers should also be prepared in AMS-TeX or LaTeX style and should be typed according to the style given in the journal homepage: <http://ijfs.usb.ac.ir>

## **Submission of Manuscripts**

Manuscripts submitted for publication should be sent electronically to this URL address: <http://ijfs.usb.ac.ir> in pdf format.

## **Proofs and Reprints**

Page proofs will be sent to the corresponding author to be checked for type setting and editing. There are no page charges and authors will receive only complimentary electronic reprint file.

## **Proposing Special Issue**

If you are interested in proposing a special issue, please contact the editor-in-chief at: [ijfs-editor@usb.ac.ir](mailto:ijfs-editor@usb.ac.ir)

### **The journal is indexed and abstracted in:**

Science Citation Index Expanded (also known as SciSearch®)  
Journal Citation Reports/Science Edition  
Thomson ISI  
ISC (Islamic World Science Citation Center)  
Mathematical Reviews  
Zentralblatt MATH  
EBSCO  
SCOPUS

### **Journal Address**

***Iranian Journal of Fuzzy Systems***  
University of Sistan and Baluchestan, P.O. Box 98135-987  
Zahedan, Iran.  
Tel & Fax: +98-54-33431060  
E-mail: [ijfs@usb.ac.ir](mailto:ijfs@usb.ac.ir)  
Homepage: <http://ijfs.usb.ac.ir>

ISSN: 1735-0654

*Published by the University of Sistan and Baluchestan and approved by the Ministry of Science, Research and Technology of Iran and the Iranian Fuzzy Systems Society.*