

# **Modern Approaches in Fuzzy Sets, Intuitionistic Fuzzy Sets, Generalized Nets and Related Topics Volume I: Foundations**

**Editors**

**Krassimir T. Atanassov**

**Michał Baczyński**

**Józef Drewniak**

**Janusz Kacprzyk**

**Maciej Krawczak**

**Eulalia Szmidt**

**Maciej Wygralak**

**Sławomir Zadrozny**

**SRI PAS**



**IBS PAN**

**Modern Approaches in Fuzzy Sets,  
Intuitionistic Fuzzy Sets,  
Generalized Nets and Related Topics.  
Volume I: Foundations**



**Systems Research Institute  
Polish Academy of Sciences**

**Modern Approaches in Fuzzy Sets,  
Intuitionistic Fuzzy Sets,  
Generalized Nets and Related Topics.  
Volume I: Foundations**

**Editors**

**Krassimir Atanassov  
Michał Baczyński  
Józef Drewniak  
Janusz Kacprzyk  
Maciej Krawczak  
Eulalia Szmidt  
Maciej Wygralak  
Sławomir Zadrożny**

© **Copyright by Systems Research Institute  
Polish Academy of Sciences  
Warsaw 2014**

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

Systems Research Institute  
Polish Academy of Sciences  
Newelska 6, 01-447 Warsaw, Poland  
[www.ibspan.waw.pl](http://www.ibspan.waw.pl)

**ISBN 83-894-7553-7**

## Foreword

The papers presented in this Volume 1 constitute a collection of contributions, both of a foundational and applied type, by both well-known experts and young researchers in various fields of broadly perceived intelligent systems. It may be viewed as a result of fruitful discussions held during the Twelfth International Workshop on Intuitionistic Fuzzy Sets and Generalized Nets (IWIFSGN-2013) organized in Warsaw on October 11, 2013 by the Systems Research Institute, Polish Academy of Sciences, in Warsaw, Poland, Institute of Biophysics and Biomedical Engineering, Bulgarian Academy of Sciences in Sofia, Bulgaria, and WIT – Warsaw School of Information Technology in Warsaw, Poland, and co-organized by: the Matej Bel University, Banska Bystrica, Slovakia, Universidad Publica de Navarra, Pamplona, Spain, Universidade de Tras-Os-Montes e Alto Douro, Vila Real, Portugal, Prof. Asen Zlatarov University, Burgas, Bulgaria, and the University of Westminster, Harrow, UK:

<http://www.ibspan.waw.pl/ifs2013/>

The consecutive International Workshops on Intuitionistic Fuzzy Sets and Generalized Nets (IWIFSGNs) have been meant to provide a forum for the presentation of new results and for scientific discussion on new developments in foundations and applications of intuitionistic fuzzy sets and generalized nets pioneered by Professor Krassimir T. Atanassov. Other topics related to broadly perceived representation and processing of uncertain and imprecise information and intelligent systems have also been included. The Twelfth International Workshop on Intuitionistic Fuzzy Sets and Generalized Nets (IWIFSGN-2013) is a continuation of this undertaking, and provides many new ideas and results in the areas concerned.

We hope that a collection of main contributions presented at the Workshop, completed with many papers by leading experts who have not been able to participate, will provide a source of much needed information on recent trends in the topics considered.

We wish to thank all the authors for their excellent contributions and their collaboration during the editing process of the volume. We are looking forward to the same fruitful collaboration during the next Workshops of this series that are planned for the near future. Special thanks are due to the reviewers whose excellent and timely work has significantly contributed to the quality of the volume.

Warsaw, January 2014

Krassimir Atanassov  
Michał Baczyński  
Józef Drewniak  
Janusz Kacprzyk  
Maciej Krawczak  
Eulalia Szmidt  
Maciej Wygralak  
Sławomir Zadrozny

**The papers presented in this Volume 1 constitute a collection of contributions, both of a foundational and applied type, by both well-known experts and young researchers in various fields of broadly perceived intelligent systems.**

**It may be viewed as a result of fruitful discussions held during the Twelfth International Workshop on Intuitionistic Fuzzy Sets and Generalized Nets (IWIFSGN-2013) organized in Warsaw on October 11, 2013 by the Systems Research Institute, Polish Academy of Sciences, in Warsaw, Poland, Institute of Biophysics and Biomedical Engineering, Bulgarian Academy of Sciences in Sofia, Bulgaria, and WIT - Warsaw School of Information Technology in Warsaw, Poland, and co-organized by: the Matej Bel University, Banska Bystrica, Slovakia, Universidad Publica de Navarra, Pamplona, Spain, Universidade de Tras-Os-Montes e Alto Douro, Vila Real, Portugal, Prof. Asen Zlatarov University, Burgas, Bulgaria, and the University of Westminster, Harrow, UK:**

**[Http://www.ibspan.waw.pl/ifs2013](http://www.ibspan.waw.pl/ifs2013)**

**The consecutive International Workshops on Intuitionistic Fuzzy Sets and Generalized Nets (IWIFSGNs) have been meant to provide a forum for the presentation of new results and for scientific discussion on new developments in foundations and applications of intuitionistic fuzzy sets and generalized nets pioneered by Professor Krassimir T. Atanassov. Other topics related to broadly perceived representation and processing of uncertain and imprecise information and intelligent systems have also been included. The Twelfth International Workshop on Intuitionistic Fuzzy Sets and Generalized Nets (IWIFSGN-2013) is a continuation of this undertaking, and provides many new ideas and results in the areas concerned.**

**We hope that a collection of main contributions presented at the Workshop, completed with many papers by leading experts who have not been able to participate, will provide a source of much needed information on recent trends in the topics considered.**

ISBN 838947553-7

