



**I T H E A**



**International Journal**

**INFORMATION** **TECHNOLOGIES**  
&  
**KNOWLEDGE**



**2016 Volume 10 Number 3**



**International Journal  
INFORMATION TECHNOLOGIES & KNOWLEDGE**

**Volume 10 / 2016, Number 3**

**EDITORIAL BOARD**

Editor in chief: **Krassimir Markov** (Bulgaria)

<b>Abdelmgeid Amin Ali</b>	(Egypt)	<b>Larissa Zaynutdinova</b>	(Russia)
<b>Aleksey Voloshin</b>	(Ukraine)	<b>Laura Ciocoiu</b>	(Romania)
<b>Alexander Kuzemin</b>	(Ukraine)	<b>Levon Aslanyan</b>	(Armenia)
<b>Alexander Palagin</b>	(Ukraine)	<b>Luis F. de Mingo</b>	(Spain)
<b>Alexey Petrovskiy</b>	(Russia)	<b>Natalia Ivanova</b>	(Russia)
<b>Alfredo Milani</b>	(Italy)	<b>Nataliia Kussul</b>	(Ukraine)
<b>Arnold Sterenharz</b>	(Germany)	<b>Natalia Pankratova</b>	(Ukraine)
<b>Avram Eskenazi</b>	(Bulgaria)	<b>Nelly Maneva</b>	(Bulgaria)
<b>Axel Lehmann</b>	(Germany)	<b>Nikolay Lyutov</b>	(Bulgaria)
<b>Darina Dicheva</b>	(USA)	<b>Orly Yadid-Pecht</b>	(Israel)
<b>Ekaterina Solovyova</b>	(Ukraine)	<b>Rafael Yusupov</b>	(Russia)
<b>George Totkov</b>	(Bulgaria)	<b>Rumyana Kirkova</b>	(Bulgaria)
<b>Hasmik Sahakyan</b>	(Armenia)	<b>Stoyan Poryazov</b>	(Bulgaria)
<b>Iliia Mitov</b>	(Bulgaria)	<b>Tatyana Gavrilova</b>	(Russia)
<b>Irina Petrova</b>	(Russia)	<b>Vadim Vagin</b>	(Russia)
<b>Ivan Popchev</b>	(Bulgaria)	<b>Vasil Sgurev</b>	(Bulgaria)
<b>Jeanne Schreurs</b>	(Belgium)	<b>Velina Slavova</b>	(Bulgaria)
<b>Juan Castellanos</b>	(Spain)	<b>Vitaliy Lozovskiy</b>	(Ukraine)
<b>Julita Vassileva</b>	(Canada)	<b>Vladimir Ryazanov</b>	(Russia)
<b>Karola Witschurke</b>	(Germany)	<b>Volodimir Doncheko</b>	(Ukraine)
<b>Koen Vanhoof</b>	(Belgium)	<b>Martin P. Mintchev</b>	(Canada)
<b>Krassimira B. Ivanova</b>	(Bulgaria)	<b>Yuriy Zaychenko</b>	(Ukraine)
		<b>Zhili Sun</b>	(UK)

**International Journal "INFORMATION TECHNOLOGIES & KNOWLEDGE" (IJ ITK)  
is official publisher of the scientific papers of the members of  
the ITHEA International Scientific Society**

IJ ITK rules for preparing the manuscripts are compulsory.  
The **rules for the papers** for IJ ITK are given on [www.ithea.org](http://www.ithea.org)  
Responsibility for papers published in IJ ITK belongs to authors.

**International Journal "INFORMATION TECHNOLOGIES & KNOWLEDGE" Volume 10, Number 3, 2016**  
Edited by the **Institute of Information Theories and Applications FOI ITHEA**, Bulgaria, in collaboration with:  
Institute of Mathematics and Informatics, BAS, Bulgaria; V.M.Glushkov Institute of Cybernetics of NAS, Ukraine;  
Universidad Politecnica de Madrid, Spain; Hasselt University, Belgium;  
St. Petersburg Institute of Informatics, RAS, Russia; Institute for Informatics and Automation Problems, NAS of the Republic of Armenia.

**Printed in Bulgaria**

**Publisher ITHEA®**

Sofia, 1000, P.O.B. 775, Bulgaria. [www.ithea.org](http://www.ithea.org), e-mail: [info@foibg.com](mailto:info@foibg.com)

Technical editor: Ina Markova

Издател: ИТЕА®, София 1000, ПК 775, България, [www.ithea.org](http://www.ithea.org), e-mail: [info@foibg.com](mailto:info@foibg.com)

**Copyright © 2016 All rights reserved for the publisher and all authors.**

© 2007-2016 "Information Technologies and Knowledge" is a trademark of ITHEA®

© ITHEA® is a registered trademark of FOI-Commerce Co.

**ISSN 1313-0455 (printed)**

**ISSN 1313-048X (online)**