

Khaled Elleithy
Editor

Advances and Innovations in Systems, Computing Sciences and Software Engineering



 Springer

Advances and Innovations in Systems, Computing Sciences
and Software Engineering

Advances and Innovations in Systems, Computing Sciences and Software Engineering

Edited by

Khaled Elleithy

University of Bridgeport
CT, USA

 Springer

A C.I.P. Catalogue record for this book is available from the Library of Congress.

ISBN 978-1-4020-6263-6 (HB)
ISBN 978-1-4020-6264-3 (e-book)

Published by Springer,
P.O. Box 17, 3300 AA Dordrecht, The Netherlands.

www.springer.com

Printed on acid-free paper

All Rights Reserved

© 2007 Springer

No part of this work may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, microfilming, recording or otherwise, without written permission from the Publisher, with the exception of any material supplied specifically for the purpose of being entered and executed on a computer system, for exclusive use by the purchaser of the work.

To my wife and sons.

Table of Contents

| | |
|--|------|
| Preface | xv |
| Acknowledgements | xvii |
| 1. An Adaptive and Extensible Web-Based Interface System for Interactive Video Contents Browsing <i>Adrien Joly and Dian Tjondronegoro</i> | 1 |
| 2. Design and Implementation of Virtual Instruments for Monitoring and Controlling Physical Variables Using Different Communication Protocols <i>A. Montoya, D. Aristizábal, R. Restrepo, N. Montoya and L. Giraldo</i> | 7 |
| 3. Online Decision Support System for Dairy Farm <i>A. Savilionis, A. Zajančauskas, V. Petrauskas and S. Juknevičius</i> | 13 |
| 4. Decision Making Strategies in Global Exchange and Capital Markets <i>Aleksandras Vytautas Rutkauskas and Viktorija Stasytyte</i> | 17 |
| 5. A Simple and Efficient Solution for Room Synchronization Problem in Distributed Computing <i>Alex A. Aravind</i> | 23 |
| 6. Improving Computer Access for Blind Users <i>Amina Bouraoui and Mejdi Soufi</i> | 29 |
| 7. Developing a Multi-Agent System for Dynamic Scheduling Trough AOSE Perspective <i>Ana Madureira, Joaquim Santos, Nuno Gomes and Ilda Ferreira</i> | 35 |
| 8. Criminal Sentencing, Intuition and Decision Support <i>Andrew Vincent, Tania Sourdin and John Zeleznikow</i> | 41 |
| 9. An Approach for Invariant Clustering and Recognition in Dynamic Environment <i>Andrey Gavrilov and Sungyoung Lee</i> | 47 |
| 10. Modelling non Measurable Processes by Neural Networks: Forecasting Underground Flow Case Study of the Cèze Basin (<i>Gard - France</i>) <i>A. Johannet, P.A. Ayrat and B. Vayssade</i> | 53 |
| 11. Significance of Pupil Diameter Measurements for the Assessment of Affective State in Computer Users <i>Armando Barreto, Jing Zhai, Naphtali Rishe and Ying Gao</i> | 59 |
| 12. A Novel Probing Technique for Mode Estimation in Video Coding Architectures <i>Ashoka Jayawardena</i> | 65 |
| 13. The Effects of Vector Transform on Speech Compression <i>B.D. Barkana & M.A. Cay</i> | 67 |
| 14. Software Development Using an Agile Approach for Satellite Camera Ground Support Equipment <i>D. dos Santos, Jr., I. N. da Silva, R. Modugno, H. Pazelli and A. Castellar</i> | 71 |

| | | |
|-----|--|-----|
| 15. | Priming the Pump: Load Balancing Iterative Algorithms <i>David J. Powers</i> | 77 |
| 16. | An Ontology for Modelling Flexible Business Processes <i>Denis Berthier</i> | 83 |
| 17. | Routing Free Messages Between Processing Elements in a Hypercube with Faulty Links <i>Dinko Gichev</i> | 89 |
| 18. | OPTGAME: An Algorithm Approximating Solutions for Multi-Player Difference Games <i>Doris A. Behrens and Reinhard Neck</i> | 93 |
| 19. | Rapid Development of Web Applications with Web Components <i>Dzenan Ridjanovic</i> | 99 |
| 20. | Mesh-adaptive Methods for Viscous Flow Problem with Rotation <i>E. Gorshkova, P. Neittaanmaki and S.Repin</i> | 105 |
| 21. | Metamodel-based Comparison of Data Models <i>Erki Eessaar</i> | 109 |
| 22. | BEMGA: A HLA Based Simulation Modeling and Development Tool <i>Ersin Ünsal, Fatih Erdoğan Sevilgen</i> | 115 |
| 23. | Comparison of Different POS Tagging Techniques (n-gram, HMM and Brill's tagger) for Bangla <i>Fahim Muhammad Hasan</i> | 121 |
| 24. | Real-Time Simulation and Data Fusion of Navigation Sensors for Autonomous Aerial Vehicles <i>Francesco Esposito, Domenico Accardo, and Antonio Moccia</i> | 127 |
| 25. | Swarm-based Distributed Job Scheduling in Next-Generation Grids <i>Francesco Palmieri and Diego Castagna</i> | 137 |
| 26. | Facial Recognition with Singular Value Decomposition <i>Guoliang Zeng</i> | 145 |
| 27. | The Application of Mobile Agents to Grid Monitor Services <i>Guoqing Dong and Weiqin Tong</i> | 149 |
| 28. | Expanding the Training Data Space Using Bayesian Test <i>Hamad Alhammady</i> | 155 |
| 29. | A Multi-Agent Framework for Building an Automatic Operational Profile <i>Hany EL Yamany and Miriam A.M. Capretz</i> | 161 |
| 30. | An Efficient Interestingness Based Algorithm for Mining Association Rules in Medical Databases <i>Siri Krishan Wasan, Vasudha Bhatnagar and Harleen Kaur</i> | 167 |

| | | |
|-----|---|-----|
| 31. | NeSReC: A News Meta-Search Engines Result Clustering Tool <i>Hassan Sayyadi, Sara Salehi and Hassan AbolHassani</i> | 173 |
| 32. | Automatic Dissemination of Text Information Using the EBOTS System <i>Hemant Joshi and Coskun Bayrak</i> | 179 |
| 33. | Mapping State Diagram to Petri Net : An Approach to Use Markov Theory for Analyzing Non-functional Parameters <i>H. Motameni, A. Movaghar, M. Siasifar, M. Zandakbari and H. Montazeri</i> | 185 |
| 34. | A Distributed Planning & Control Management Information System for Multi-site Organizations <i>Ioannis T. Christou and Spyridon Potamianos</i> | 191 |
| 35. | Supporting Impact Analysis by Program Dependence Graph Based Forward Slicing <i>Jaakko Korpi and Jussi Koskinen</i> | 197 |
| 36. | An Analysis of Several Proposals for Reversible Latches <i>J. E. Rice</i> | 203 |
| 37. | Implementation of a Spatial Data Structure on a FPGA <i>J. E. Rice, W. Osborn and J. Schultz</i> | 207 |
| 38. | Security Management: Targets, Essentials and Implementations <i>Zhao Jing and Zheng Jianwu</i> | 211 |
| 39. | Application of Fuzzy Set Ordination and Classification to the Study of Plant Communities in Pangquangou Nature Reserve, China <i>Jin-tun Zhang and Dongpin Meng</i> | 217 |
| 40. | On Searchability and LR-Visibility of Polygons <i>John Z. Zhang</i> | 223 |
| 41. | Swarm Intelligence in Cube Selection and Allocation for Multi-Node OLAP Systems <i>Jorge Loureiro and Orlando Belo</i> | 229 |
| 42. | Developing Peer-to-Peer Applications with MDA and JXTA <i>José Geraldo de Sousa Junior and Denivaldo Lopes</i> | 235 |
| 43. | A Case Study to Evaluate Templates & Metadata for Developing Application Families <i>José Lamas Ríos and Fernando Machado-Piriz</i> | 241 |
| 44. | Application of Multi-Criteria to Perform an Organizational Measurement Process <i>Josyleuda Melo Moreira de Oliveira, Karlson B. de Oliveira, Ana Karoline A. de Castro, Plácido R. Pinheiro and Arnaldo D. Belchior</i> | 247 |
| 45. | Institutionalization of an Organizational Measurement Process <i>Josyleuda Melo Moreira de Oliveira, Karlson B. de Oliveira, Arnaldo D. Belchior</i> | 253 |

| | | |
|-----|---|-----|
| 46. | Decomposition of Head Related Impulse Responses by Selection of Conjugate Pole Pairs <i>Kenneth John Faller II, Armando Barreto, Navarun Gupta and Naphtali Rishe</i> | 259 |
| 47. | GIS Customization for Integrated Management of Spatially Related Diachronic Data <i>K. D. Papadimitriou and T. Roustanis</i> | 265 |
| 48. | BlogDisc: A System for Automatic Discovery and Accumulation of Persian Blogs <i>Kyumars Sheykh Esmaili, Hassan Abolhassani and Zeinab Abbassi</i> | 269 |
| 49. | Fuzzy Semantic Similarity Between Ontological Concepts <i>Ling Song, Jun Ma, Hui Liu, Li Lian and Dongmei Zhang</i> | 275 |
| 50. | Research on Distributed Cache Mechanism in Decision Support System <i>LIU Hui and JI Xiu-hua</i> | 281 |
| 51. | Research on Grid-based and Problem-oriented Open Decision Support System <i>Liu Xia, Xueguang Chen, Zhiwu Wang and Qiaoyun Ma</i> | 285 |
| 52. | Development and Analysis of Defect Tolerant Bipartite Mapping Techniques for Programmable Cross-points in Nanofabric Architecture <i>Mandar Vijay Joshi and Waleed Al-Assadi</i> | 289 |
| 53. | Nash Equilibrium Approach to Dynamic Power Control in DS-CDMA Systems <i>J. Qasimi M and M. Tahernezhad</i> | 295 |
| 54. | Natural Language Processing of Mathematical Texts in mArachna <i>Marie Blanke, Sabina Jeschke, Nicole Natho, Ruedi Seiler and Marc Wilke</i> | 301 |
| 55. | Humanization of E-Services: Human Interaction Metaphor in Design of E-Services <i>Mart Murdvee</i> | 307 |
| 56. | Introducing the (POSSDI) Process <i>Mohammad A. ALGhalayini and Abad Shah</i> | 313 |
| 57. | Infrastructure for Bangla Information Retrieval in the Context of ICT for Development <i>Nafid Haque, M. Hammad Ali, Matin Saad Abdullah and Mumit Khan</i> | 325 |
| 58. | An Improved Watermarking Extraction Algorithm <i>Ning Chen and Jie Zhu</i> | 331 |
| 59. | Building Knowledge Components to Enhance Frequently Asked Question <i>Noreen Izza Arshad, Savita K. Sugathan, Mohamed Imran M. Ariff and Siti Salwa A. Aziz</i> | 337 |
| 60. | Semantic Representation of User's Mental Trust Model <i>Omer Mahmood and John D Haynes</i> | 345 |
| 61. | Access Concurrents Sessions Based on Quorums <i>Ousmane THIARE, Mohamed NAIMI and Mourad GUEROUI</i> | 351 |

| | | |
|-----|---|-----|
| 62. | A Dynamic Fuzzy Model for Processing Lung Sounds <i>P.A. Mastorocostas, D.N. Varsamis, C.A. Mastorocostas and C.S. Hilas</i> | 357 |
| 63. | A Formal Specification in JML of Java Security Package <i>Poonam Agarwal, Carlos E. Rubio-Medrano, Yoonsik Cheon and Patricia. J Teller</i> | 363 |
| 64. | Enterprise Integration Strategy of Interoperability <i>Raymond, Cheng-Yi Wu and Jie Lu</i> | 369 |
| 65. | A Method for Consistent Modeling of Zachman Framework Cells <i>S. Shervin Ostadzadeh, Fereidoon Shams Aliee and S. Arash Ostadzadeh</i> | 375 |
| 66. | Beyond User Ranking: Expanding the Definition of Reputation in Grid Computing <i>Said Elnaffar</i> | 381 |
| 67. | A Comparative Study for Email Classification <i>Seongwook Youn and Dennis McLeod</i> | 387 |
| 68. | Noise Reduction for VoIP Speech Codecs Using Modified Wiener Filter <i>Seung Ho Han, Sangbae Jeong, Heesik Yang, Jinsul Kim, Won Ryu, and Minsoo Hahn</i> | 393 |
| 69. | A Formal Framework for “Living” Cooperative Information Systems <i>Shiping Yang and Martin Wirsing</i> | 399 |
| 70. | Crime Data Mining <i>Shyam Varan Nath</i> | 405 |
| 71. | Combinatorial Hill Climbing Using Micro-Genetic Algorithms <i>Spyros A. Kazarlis</i> | 411 |
| 72. | Alternate Paradigm for Navigating the WWW Through Zoomable User Interface <i>Sumbul Khawaja, Asadullah Shah and Kamran Khowaja</i> | 417 |
| 73. | A Verifiable Multi-Authority E-Voting Scheme for Real World Environment <i>T. Taghavi, M. Kahani and A. G. Bafghi</i> | 421 |
| 74. | Stochastic Simulation as an Effective Cell Analysis Tool <i>Tommaso Mazza</i> | 427 |
| 75. | Bond Graph Causality Assignment and Evolutionary Multi-Objective Optimization <i>Tony Wong, Gilles Cormier</i> | 433 |
| 76. | Multi-Criteria Scheduling of Soft Real-Time Tasks on Uniform Multiprocessors Using Fuzzy Inference <i>Vahid Salmani, Mahmoud Naghibzadeh, Mohsen Kahani and Sedigheh Khajouie Nejad</i> | 439 |
| 77. | A Finite Element Program Based on Object-Oriented Framework for Spatial Trusses <i>Vedat TOĞAN and Serkan BEKİROĞLU</i> | 445 |

| | | |
|-----|---|-----|
| 78. | Design for Test Techniques for Asynchronous NULL Conventional Logic (NCL) Circuits <i>Venkat Satagopan, Bonita Bhaskaran, Waleed K. Al-Assadi, Scott C. Smith and Sindhu Kakarla</i> | 451 |
| 79. | Ant Colony Based Algorithm for Stable Marriage Problem <i>Ngo Anh Vien, Nguyen Hoang Viet, Hyun Kim, SeungGwan Lee and TaeChoong Chung</i> | 457 |
| 80. | Q-Learning Based Univector Field Navigation Method for Mobile Robots <i>Ngo Anh Vien, Nguyen Hoang Viet, HyunJeong Park, SeungGwan Lee and TaeChoong Chung</i> | 463 |
| 81. | Statistical Modeling of Crosstalk Noise in Domino CMOS Logic Circuits <i>Vipin Sharma and Waleed K. Al-Assadi</i> | 469 |
| 82. | A Decision Making Model for Dual Interactive Information Retrieval <i>Vitaliy Vitsentiy</i> | 475 |
| 83. | Business Rules Applying to Credit Management <i>Vladimir Avdejenkov and Olegas Vasilecas</i> | 481 |
| 84. | Information System in Atomic Collision Physics <i>V.M. Cvjetković, B.M. MarinKović and D. Šević</i> | 485 |
| 85. | Incremental Learning of Trust while Reacting and Planning <i>W. Froelich, M. Kisiel-Dorohinicki and E. Nawarecki</i> | 491 |
| 86. | Simulation of Free Feather Behavior <i>Xiaoming Wei, Feng Qiu and Arie Kaufman</i> | 497 |
| 87. | Evolutionary Music Composer Integrating Formal Grammar <i>Yaser M.A. Khalifa, Jasmin Begovic, Badar Khan, Airrion Wisdom and M. Basel Al-Mourad</i> | 503 |
| 88. | A New Algorithm and Asymptotical Properties for the Deadlock Detection Problem for Computer Systems with Reusable Resource Types <i>Youming Li and Robert Cook</i> | 509 |
| 89. | On Path Selection for Multipath Connection <i>Yu Cai and C. Edward Chow</i> | 513 |
| 90. | Some Results on the Sinc Signal with Applications to Intersymbol Interference in Baseband Communication Systems <i>Zouhir Bahri</i> | 519 |
| 91. | Multi-Focus Image Fusion Using Energy Coefficient Matrix <i>Adnan Mujahid Khan, Mudassir Fayyaz and Asif M. Gillani</i> | 525 |

| | | |
|-----|--|-----|
| 92. | Measuring Machine Intelligence of an Agent-Based Distributed Sensor Network System <i>Anish Anthony and Thomas C. Jannett</i> | 531 |
| 93. | Image Processing for the Measurement of Flow Rate of Silo Discharge <i>Cédric DEGOUET, Blaise NSOM, Eric LOLIVE and André GROHENS</i> | 537 |
| 94. | A Blind Watermarking Algorithm Based on Modular Arithmetic in the Frequency Domain <i>Cong Jin, Zhongmei Zhang, Yan Jiang, Zhiguo Qu and Chuanxiang Ma</i> | 543 |
| 95. | Determination of Coordinate System in Short-axis View of Left Ventricle <i>Gaurav Sehgal, Gabrielle Horne and Peter Gregson</i> | 549 |
| 96. | On-line Modeling for Real-time, Model-Based, 3D Pose Tracking <i>Hans de Ruiter and Beno Benhabib</i> | 555 |
| 97. | Grid Enabled Computer Vision System for Measuring Traffic Parameters <i>Ivica Dimitrovski, Gorgi Kakasevski, Aneta Buckovska, Suzana Loskovska and Bozidar Proevski</i> | 561 |
| 98. | Physically Constrained Neural Network Models for Simulation <i>J. E. Souza de Cursi and A. Koscianski</i> | 567 |
| | Index | 573 |

Preface

This book includes Volume I of the proceedings of the 2006 International Conference on Systems, Computing Sciences and Software Engineering (SCSS). SCSS is part of the International Joint Conferences on Computer, Information, and Systems Sciences, and Engineering (CISSE 06). The proceedings are a set of rigorously reviewed world-class manuscripts presenting the state of international practice in Advances and Innovations in Systems, Computing Sciences and Software Engineering.

SCSS 06 was a high-caliber research conference that was conducted online. CISSE 06 received 690 paper submissions and the final program included 370 accepted papers from more than 70 countries, representing the six continents. Each paper received at least two reviews, and authors were required to address review comments prior to presentation and publication.

Conducting SCSS 06 online presented a number of unique advantages, as follows:

- All communications between the authors, reviewers, and conference organizing committee were done on line, which permitted a short six week period from the paper submission deadline to the beginning of the conference.
- PowerPoint presentations, final paper manuscripts were available to registrants for three weeks prior to the start of the conference.
- The conference platform allowed live presentations by several presenters from different locations, with the audio and PowerPoint transmitted to attendees throughout the internet, even on dial up connections. Attendees were able to ask both audio and written questions in a chat room format, and presenters could mark up their slides as they deem fit.
- The live audio presentations were also recorded and distributed to participants along with the power points presentations and paper manuscripts within the conference DVD.

The conference organizers are confident that you will find the papers included in this volume interesting and useful.

Khaled Elleithy, Ph.D.
Bridgeport, Connecticut
June 2007

Acknowledgements

The 2006 International Conference on Systems, Computing Sciences and Software Engineering (SCSS) and the resulting proceedings could not have been organized without the assistance of a large number of individuals. SCSS is part of the International Joint Conferences on Computer, Information, and Systems Sciences, and Engineering (CISSE). I had the opportunity to co-found CISSE in 2005, with Professor Tarek Sobh, and we set up mechanisms that put it into action. Andrew Rosca wrote the software that allowed conference management, and interaction between the authors and reviewers online. Mr. Tudor Rosca managed the online conference presentation system and was instrumental in ensuring that the event met the highest professional standards. I also want to acknowledge the roles played by Sarosh Patel and Ms. Susan Kristie, our technical and administrative support team.

The technical co-sponsorship provided by the Institute of Electrical and Electronics Engineers (IEEE) and the University of Bridgeport is gratefully appreciated. I would like to express my thanks to Prof. Toshio Fukuda, Chair of the International Advisory Committee and the members of the SCSS Technical Program Committee, including: Abdelaziz AlMulhem, Alex A. Aravind, Ana M. Madureira, Mostafa Aref, Mohamed Dekhil, Julius Dichter, Hamid Mcheick, Hani Hagra, Marian P. Kazmierkowski, Low K.S., Michael Lemmon, Rafa Al-Qutaish, Rodney G. Roberts, Sanjiv Rai, Samir Shah, Shivakumar Sastry, Natalia Romalis, Mohammed Younis, Tommaso Mazza, and Srin Ramaswamy.

The excellent contributions of the authors made this world-class document possible. Each paper received two to four reviews. The reviewers worked tirelessly under a tight schedule and their important work is gratefully appreciated. In particular, I want to acknowledge the contributions of the following individuals: Yongsuk Cho, Michael Lemmon, Rafa Al-Qutaish, Yaser M. A. Khalifa, Mohamed Dekhil, Babar Nazir, Khaled Hayatleh, Mounir Bousbia-Salah, Rozlina Mohamed, A. Sima Etner-Uyar, Hussein Abbass, Ahmad Kamel, Emmanuel Udoh, Rodney G. Roberts, Vahid Salmani, Dongchul Park, Sergiu Dumitriu, Helmut Vieritz, Waleed Al-Assadi, Marc Wilke, Mohammed Younis, John Zhang, Feng-Long Huang, Natalia Romalis, Hamid Mcheick, Minkoo Kim, Khaled Rasheed, Chris Panagiotakopoulos, Alex Aravind, Dinko Gichev, Dirk Mueller, Andrew Vincent, Ana Madureira, Abhilash Geo Mathews, Yu Cai, Spyros Kazarlis, Liu Xia, Pavel Osipov, Hamad Alhammady, Fadel Sukkar, Jorge Loureiro, Hemant Joshi, Hossam Fahmy, Yoshiteru Ishida, Min Jiang, Vien Ngo Anh, Youming Li, X. Sheldon Wang, Nam Gyu Kim, Vasso Stylianou, Tommaso Mazza, Radu Calinescu, Nagm Mohamed, Muhammad Ali, Raymond Wu, Mansour Tahernehzadi, Trevor Carlson, Sami Habib, Vikas Vaishnav, Vladimir Avdejenkov, Volodymyr Voytenko, Vygantas Petrauskas, Shivakumar Sastry, U. B. Desai, Julius Dichter, Hani Hagra, Giovanni Morana, Mohammad Karim, Thomas Nitsche, Rosida Coowar, Anna Derezinska, Amala Rajan, Aleksandras Vytautas Rutkauskas, A. Ismail, Mostafa Aref, Ahmed Abou-Alfotouh, Damu Radhakrishnan, Sameh ElSharkawy, George Dimitoglou, Marian P. Kazmierkowski, M. Basel Al-Mourad, Ausif Mahmood, Nawaf Kharma, Fernando Guarin, Kaitung Au, Joanna Kolodziej, Ugur Sezerman, Yujen Fan, Zheng Yi Wu, Samir Shah, Sudhir Veerannagari, Junyoung Kim and Sanjiv Rai.

Khaled Elleithy, Ph.D.
Bridgeport, Connecticut
June 2007

Information System in Atomic Collision Physics

V.M. Cvjetković
Faculty of Science
Radoja Domanovića 12
34000 Kragujevac, Serbia
B. M. Marinković
Institute of Physics
Pregrevica 129
11000 Belgrade, Serbia
D. Šević
Institute of Physics
Pregrevica 129
11000 Belgrade, Serbia

Abstract - Fundamental aspects of scientific research in the field of atomic physics are discussed in this paper from the point of view of information system that would cover the most important phases of research. Such information system should encompass the complexity of scientific research trying to incorporate data scattered in various books, articles, research centers, databases, etc. We started from scratch with principal analysis of basic research processes and data that represent needs and condensed research experience. Particular problem of search for data is specially discussed and the main idea for new proposed approach is described. We developed a prototype of information system to be used by researchers in various research phases. Search for data is based on the web, as it is the standard way for easy data access.

I. INTRODUCTION

Organizing of any research implies several stages of activity. It starts with defining the process of interest, getting information about published data concerning the chosen processes, planning the research by choosing the methods and parameters, then performing research, obtaining and processing data and finally presenting and publishing results in appropriate form. Each of these stages could be time consuming and there is no doubt that specific research could last for years.

In this paper we have developed the logical model of Information System (IS) in the field of Atomic Collision Physics (ACP). The model should reflect all stages of activities. It is also implemented as a web application based on developed logical model. The aim of such IS is to facilitate the search for published data in a specific field of ACP, to make possible the critical evaluation of published data and used methods of research, as well as to keep track of own research. During the same period of time, the thematic of research could be changed and/or increased in sense of new results or new methodology invented.

Research activity has complex structure and its stages overlap not only in time domain, but also in domain of concepts. That often leads the researchers to repeat the same activity that is usually unnecessary. In planning own research, the researchers have at their disposal only the extensive databases of whole publications that can usually be browsed by

authors and keywords. However, the analysis of research procedures is left to researchers. That analysis in its essence includes the reading of the whole text i.e., expressed in the informatics terms, the selection of research categories by "free text search". Also, there are available specific databases that include numeric or graphics data but without any knowledge considering the methodology, preparation, parameters describing how data were obtained, and these are the key for evaluation of existing research. Without such performed analysis, these numerical results could hardly be compared or evaluated. There is no IS available that would comprise the research process in whole.

Large number of data bases exist on the Internet nowadays, that cover the field of atomic and molecular physics. Atomic and molecular databases can be divided in two main groups, numerical and bibliographical databases. Numerical databases are specific and comprise for instance Fundamental Physical Constants – NIST [1], spectroscopic data, data for collision processes, etc. Some representatives of these databases are NIST Atomic Spectroscopic Data [2], NIST Molecular Spectroscopic Data [3], TOPbase [4], Center for Astrophysics, Atomic and Molecular Physics Division [5] for spectroscopic data, and NIFS [6], NIST [7], IAEA ALADDIN [8], Atomic Data for Astrophysics, Univ. Kentucky, USA [9] for collisional processes data.

Bibliographical databases are somewhat less numbered, and there are also two basic kinds - spectroscopic and databases for collision processes. Bibliographical databases for spectroscopy are for instance NIST [10], STARK [11], while collision are IAEA [12], GAPHYOR [13], ORNL CFADC [14] etc.

There are also systems that act as "search engines" for databases, collecting data from several databases. Typical representative is GENIE [15] collecting data from nine different databases throughout the world, among which are some of the above mentioned. The other representative is DANSE [16] that was developed for the ICAMDATA [17] 2002, Gatlinburg, Tennessee. Most of the features in DANSE are still in the

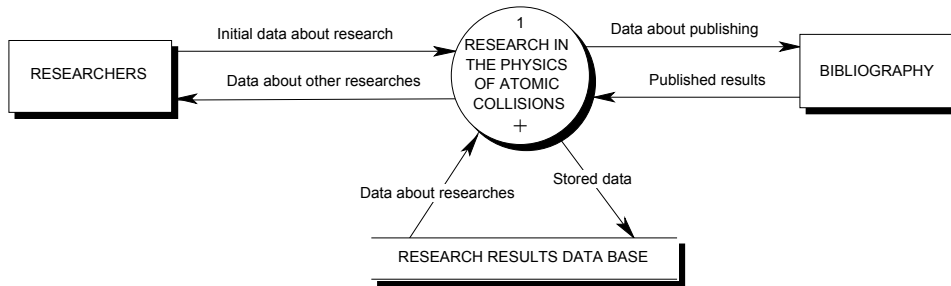


Fig. 1. Context diagram of the function RPAC

preparation level. There are systems that offer online computing for calculation of some important specific atomic features like AAEXCITE [18] and RATES [19]. All mentioned examples are undoubtedly very important and contain large number of valuable data at disposal for scientists committing various researches thru ought the world. On the other side, these databases are specific for some area and offer search for data based on criteria that are most frequently used, not necessarily optimal for any research. Also, these databases are no complete, and in general they lack customization. Therefore, the support for research is only partial, not to mention that they are just “one way” and generally do not offer the easy input or storing of some specific data of interest for current ongoing research or for the whole field of activity.

The proposed answer to all the mentioned could be the creation of Information System (IS) designed to support specific research tasks, but at the same time to be based on ground wide enough to provide common foundation for research in the area of atomic and molecular physics. The significance of existing databases will be primarily to serve as the source for data of interest for the given institution.

The basic idea for IS that is developed here would be to serve as a tool for researcher, which implies that it should comprise as much of research activities in all stages, as possible. As the IS was made from scratch, the starting point for designing such IS are detailed and elaborated process model and data model. Process model is largely based on, and expresses the knowledge and the long term experience of researchers in the ACP field. Process model also served as a guideline for the data model. During data modeling, very important concept or idea emerged and became the unique characteristic of this IS. We call it the Expert Decomposition of the Article (EDA). It expresses the semantic meaning of the article text being analyzed, using a number of selected, universal, most important notions that characterize the research in the area of ACP. EDA enables the IS to selectively store the most important data that characterize the research described in the article, and these include results of numerical and graphical type, important parameters, preparation, methodology, used particles, bibliographical and other data. In that way, the IS contains the most necessary data that characterize the research, without the need to contain the full text of the article, as it can be obtained by well known means. This IS also enables very selective and efficient data retrieval such as particular numerical or graphical results, that are obtained on the basis of

expert characterization of results. By forming the complex search condition consisting of mentioned notions obtained by EDA, researcher can quickly obtain particular research results with corresponding bibliographical data. Whether the search yields results or not, researcher spends minimum time on the search through numerous scientific articles. Testing of the partial implementation of the IS that contains some decomposed scientific articles, confirms the basic expectations, and thus justifies the fundamental structure of the IS.

In the following text, process and data models are presented in order to describe the specific “science research” system and to give the basis for EDA. After that, EDA its use and possibilities with some implementation details are discussed.

II. PROCESS MODEL

Process model defines those processes from the research area of atomic physics that are to be modeled and supported by the appropriate informational technology. Generally, all activities performed by researchers that contribute to scientific research are described as Research in the Physics of Atomic Collisions (RPAC). In the process model, it is represented by the corresponding RPAC function. All other activities are derived from that function by the process of hierarchical decomposition. On the highest hierarchical level - context level, process model can be represented with Data Flow Diagram (DFD) as shown in Fig 1. Researchers perform the RPAC function, and publish the research results in some of the bibliographical forms. For obtaining necessary data for other researches in this area, researchers have the opportunity to search the existing database. Database also serves as storage for own research results, and research results of other researchers. Researchers supply the RPAC function with initial data for the research that they plan, and from the RPAC function they get data about other earlier published researches. Data flows between RPAC function and bibliography as the element from its surrounding, are established in both directions, so that RPAC gives data for publishing, and also accepts published results from the earlier performed researches. To make the search for data more effective, RPAC stores new and published data in Research Results Database.

RPAC function is a complex one, as it encompasses all research activities. For more detailed analysis, it has to be decomposed on a number of hierarchical levels. The structure for the next level can be obtained by following reasoning.

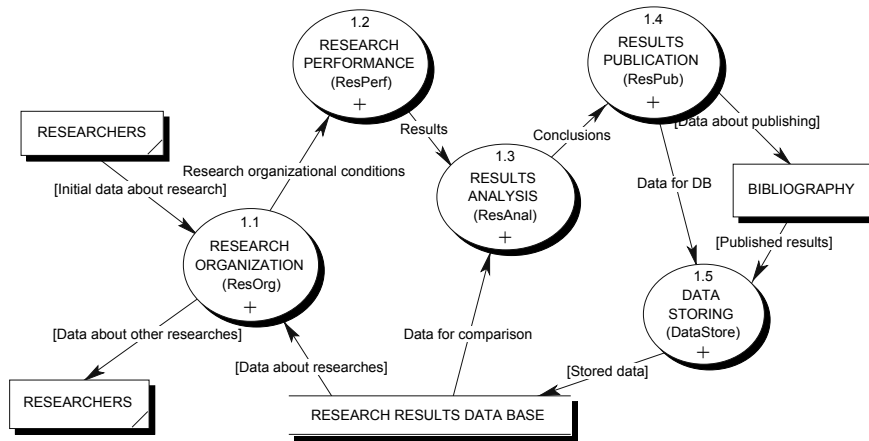


Fig 2 DFD of the decomposed RPAC function

Researchers, on the base of the set aim, define criteria for searching and make insight into available data from the earlier performed researches. In this procedure, which can be iterative, initial conditions of the planned research are prepared, i.e. preparation for computer aided research, and for its organization is performed. After the organizing process is over, the next step is performing of the research in which the measurement of the observed phenomenon is made, i.e. some results are obtained. By the analysis of these results certain conclusions are drawn, that are the basis for their publishing. In the phase of publishing there are two important activities. On one side relevant data and information are published in some of the bibliographical forms, and on the other preparation of data is made for their processing and storing in the information system database. Processing and storing in the database is also enabled for data that were published earlier. Accordingly, RPAC function can be decomposed on sub processes as shown in corresponding DFD on Fig. 2. This data flow diagram makes the first decomposition level.

III DATA MODEL

Data model implemented here is relational and it is developed up to the level of recognition of all the entities. It defines identifiable and descriptive attributes of entities, relationships between entities and properties of these relationships, in details enough for implementation.

DFD's that describe the process model are defined both on the context level and on the following two or three levels of decomposition (not discussed here in detail). While the processes are the basis for design of the process logical and physical model that has to enable data transformation from input to output data flows, the very data flows are the basis for defining the data logical and physical model. In the following text on the basis of data flows analysis, the structure of the relational model for support of the RPAC function is given. This is achieved by using the diagrams of the parts of whole model with symbolic according to Integration Definition for Information Modeling (IDEF1X) [20] standards, and which

relates to development of the data logical model. For that purpose, method of logical design for data modeling and database design - "Entity-Relationship Modeling" ("ER" modeling) was used. Analysis of the data flows in DFD's of the function RPAC data model, led to independent entities and their characteristics. As a result, the following entities are considered in data model: Author, Laboratory, Country, Editor, Journal, Publication, Particle, Preparation, Process, Interaction Method, Method, Parameter, Research, Quantity, Result, Table Result, and Graph.

Data model consists of two main sub models, the first describing entities and their relationships important for publishing, and the other describing entities and their relationships important for experiment or research. Entity relationship diagram for the whole data model is shown in Fig. 3.

Experiment is the central entity of the data model. It gathers around and connects all the other entities. That model characteristic corresponds to the fact that experiment is the central part of research in the ACP.

Upper left part of the data model in Fig. 3 includes entities and relationships that are important for publishing. Publication can contain one or more experiments. Experiment can be understood here in wider context, and can include both theoretical and experimental research.

Particle is subject of the research in the physics of atomic collisions. In experiment particle can appear in two roles, as a target and as a projectile. Every particle can be in both roles. Particle can be categorized to chemical element – atom or compound – molecule, that can be ionized or not. Chemical element compound describe some common physical and chemical characteristics for atoms and molecules. Besides, particle can be electron or photon, that are simple elementary particles with very well known attributes, so there is no need for photon or electron entities. It is enough just to evident photon or electron. Some characteristics like energy, polarization can be specified as parameters or with Preparation entity.

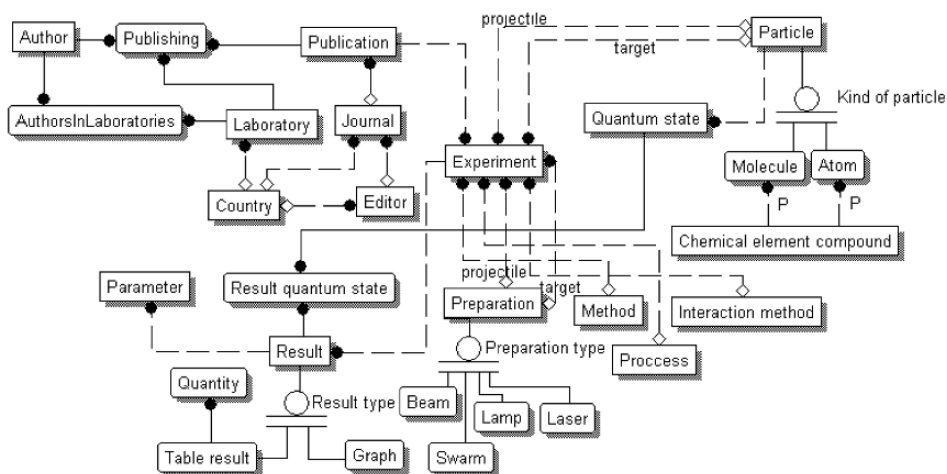


Fig. 3. Relational data model diagram

Preparation is the entity used to describe the form in which the particle is during the experiment performance. Particle can be prepared in the form of light beam (laser, lamp), particle beam, swarm and gas cell, independently from whether it has the role of projectile or target in the experiment. Not all combinations of particles and preparations are allowed depending on whether the particle is photon (laser or lamp) or not (beam and swarm). Particles in atomic physics – atoms and molecules are characterized by quantum states, as it is usual way of describing particles that are governed by the laws of quantum physics. For each particle there can be number of quantum states that also depend on degree of particle ionization.

Result is outcome of every experiment and its final aim. Results can be displayed in many forms: tabular, graphical, descriptive texts and combined.

Process is the kind of interaction between particles with the target role and particles with projectile role during the experiment. It can be elastic scattering, excitation, ionization, absorption, decomposition, etc.

Interaction method describes interaction between target particle and projectile during the experiment.

Method is the way the research of some process in physics of atomic collisions is made.

Parameter is characteristic that can be used for additional description of some research. The need for use of the Parameter entity appears if some specific property of the research being performed has to be defined. Using parameters, it is possible to enter in database quite arbitrary data that are necessary to further characterize the research, in addition to model entities.

IV IS MAIN CHARACTERISTICS

When searching for very specific data like experimental results from some research, that can not be retrieved by keyword search, even when data are in some kind of electronic

form, one has to know in advance where to look for, exact references, titles, authors, etc. If the fact whether some result is published or not, or where it is published is not known to researcher, than there is high probability that the necessary data if exist, will remain hidden somewhere in the huge mass of published literature. In the case of experimental results in atomic physics, search for results is complex one for the simple reason that the given result is connected or depends on a number of characteristics - parameters that characterize it. The intention is to create a system for search and retrieval on the basis of given conditions i.e. experimental parameters. Output of the search for experimental result should contain result value or corresponding graph, values of parameters and full reference of article in which the result is published. In that way, it is possible to search for particular result starting from experimental conditions and parameters that characterize result, without knowing whether it exists or not, and where it is published. If it exists, i.e. if it is entered in data base, complete reference will be obtained as a result of search together with quantified values.

Search is based here on fragmentation – decomposition of text into many important categories that characterize the field of investigation, in this case atomic collisions. Of course, principles are of universal kind, and are directly applicable to other areas. Main categories for text fragmentation of the article or book contents are in principle the same as independent entities that arose in the data model of information system. Those entities are for instance Author, Publication, Laboratory, Projectile Particle, Target Particle, Process, Method, Interaction Method, Parameter, Variable Quantity, Measured Quantity, and others already mentioned in the previous section. Entity named publication contains data about texts and documents that were published and fragmented. For the time being, the necessary work on text fragmentation is human, more precisely the expert, as the document fragmentation must be done by people very well acquainted with the research area that the given document that is analyzed

belongs to. Data resulting from the text fragmentation are stored in the tables of the database that ensures minimum redundancy of data and that the fragmentation of the given text has to be done only once, but that the results of fragmentation can be used unlimited number of times by various people.

Fragmentation categories could be viewed as dimensions of text, and data for each category resulting from fragmentation as particular coordinate values, thus positioning the analyzed text into some kind of point in multidimensional space in which the document resides. With such concepts introduced, we could say that the search is to be performed by giving one or more "coordinate" values, and checking the set of "points" thus obtained.

Second very important specificity of such approach is to realize that no text or document has to be in the underlying database, but just the data resulting from the text decomposition or fragmentation. Search would yield just the one or more particular results from articles or books that were already fragmented - analyzed. The useful information obtained in such way besides results, is the complete reference to text, enabling researcher to find it in a conventional way (library or publisher's documentation), not the text itself. This information system is not to compete with the library, but is rather complementary one.

V EXAMPLES OF IMPLEMENTATION

Access to data – information retrieval, in this IS is based on the WEB server. Certain access, review and search are also possible from the interfaces of programs for data entry. Data search can be performed in many ways and specially allows specific search for experiments results, that is one of the most important characteristic of IS structure and implementation. Currently implemented search consists of "Search for publications" and "Search for results". Those two kinds of the search are complementary from the aspect of starting data, but both enable access to particular results in publications.

Search for publications can in principal start from various groups of data – categories that can be selected. Possible groups of data are authors, particles, processes, methods, and journals – independent entities in data model. As this kind of search resembles classic search with keywords, (although it is not) attention will be paid to search for results.

The other, complementary kind of search starts from data that describe particular results in the research. Fig. 4 gives the web page with overview of quantities that define particular experiment result. Combo box on the top gives the list of various result types, with DCS value selected. Differential cross section (DCS) is one of the basic quantities that are measured in collision type experiments. Evidenced particles in database - atoms and molecules can be selected from their combo boxes. Depending on chosen particle – atom or molecule, and degree of ionization, corresponding quantum states appear in atom quantum states or molecule quantum states combo box. Quantum states characterize the state of excited target particle right after the collision. Pressing the

Fig. 4 Quantities that define experiment results

buttons named projectile particle and target particle, selected particles, quantum states and ionization are entered in text boxes below mentioned buttons. Values in these text boxes are used for results search. Text boxes with minimum and maximum energy define energy interval for projectile particles that will be used in the search. Similarly, minimum and maximum angle define the angle interval for scattered particles that will be used for search. Two groups of option buttons below are used for specifying type of particle for projectile and target. Selection in Fig. 4 is electron as projectile and atom as target. On the right there are three groups of combo boxes for specifying the attributes for interaction method, experiment method and experiment process. In the case when "Not specified yet" value is selected, corresponding attribute does not limit the search. If it is important to limit the search with some attribute, then any other value but "Not specified yet" has to be selected from corresponding combo box. After all desired adjustments are set, search starts with pressing the "Start search for result" button.

Information system is fully implemented using Microsoft technology. Microsoft Access 2002 is used for database and programs for data entry. Web server is Internet information server 5.1, which executes Active Server Pages – ASP.NET for all web pages. Contents of web pages are dynamically generated, depending on search conditions. For access to database from web server ADO.NET is used.

VI CONCLUSION

Information system in the physics of atomic collisions presented in this paper was developed with the aim to enable fast and simple access to various data, which are necessary to

every researcher. It has double role, on one side using this information system researcher can form own (local) information system, and on the other side, using the query for search, selective access to information from the bibliography is enabled. As these both sides are just parts of the same information system, it is easy to set up connection between them.

Besides, as the decomposition of articles was performed on large number of attributes, the search is not performed on "free text". That enables much faster data selection process. It is important to emphasize that data systematization in RPAC enables its use in other areas of physics or chemistry, and whereas specific data are needed (cross sections, rates, etc.).

Information system model was built so that it follows the procedures and processes that researcher goes through during consideration, organization and realization of his experiment. Process model presented in this paper is in fact the logical decomposition of the usual procedures of every researcher that is performed not just in physics of atomic collisions but also in majority of other areas in natural sciences. Even though here presented information system is connected by its attributes for physics of atomic collisions, its logical structure is easy adaptable to other scientific areas.

Implemented IS is based on given process and logical models, and has WEB access for data search. Described process model is not fully implemented, as it includes complex activities in research that are performed by competent scientists exclusively. Part of process model that is implemented includes activities for data input, logical consistency check of data, various kinds of local and WEB data search. Data input enables evidence of data for planned research, current research or data from any kind of reference. The main feature of data search is that it is possible to obtain particular results with full reference to article they belong to, on the basis of various selected experiment parameters. That kind of search gives researcher the unique opportunity to check whether one or more experimental results described with its parameters exist, and if it is the case, to see the value, and reference data. This kind of IS enforces various kinds of standardization, such as for given research model, article decomposition, data organization,

search for data, used verbal expressions for entities, attributes and their values.

REFERENCES

- [1] The NIST Reference on Constants, Units, and Uncertainty, <http://physics.nist.gov/cuu/index.html>
- [2] Energy levels, wavelengths and transition probabilities of atoms and ions, http://physics.nist.gov/cgi-bin/AtData/main_asd
- [3] Wavenumber tables for calibration of Infrared spectrometers and frequencies for interstellar molecular microwave transitions, <http://physics.nist.gov/PhysRefData/contents-mol.html>
- [4] Wavelength, energy level, oscillator strength, opacity, and photoionization cross sections, <http://astro.u-strasbg.fr/OP.html>
- [5] Atomic and molecular data for astronomy and aeronomy. Wavelength, energy levels, <http://cfa-www.harvard.edu/amdata/ampdata/amdata.html>
- [6] Collisional excitation, ionization, recombination, charge transfer, sputtering, and backscattering data, <http://dbshino.nifs.ac.jp/>
- [7] Electron-Impact Ionization Cross Section Database for Molecules, <http://physics.nist.gov/PhysRefData/Ionization/Xsection.html>
- [8] Collisional data, H Neutral Beam Data, Particle-Surface Interaction Data, and Data for Elementary Processes in H-He Plasmas, <http://www-amdis.iaea.org/ALADDIN/>
- [9] Photoionization, recombination, collisional ionization, autoionization, charge transfer, Auger processes, energy levels, wavelengths, transition probabilities Stark broadening, and opacities, <http://www.pa.uky.edu/~verner/atom.html>
- [10] Atomic Transition Probability Bibliographic Database, <http://physics.nist.gov/PhysRefData/Fvalbib/html/reffrm0.html>
- [11] Observatoire de Paris-Section de Meudon: Bibliography on Atomic Line Shapes and Shifts, <http://www.obspm.fr/estark>
- [12] AMBDAS, <http://www-amdis.iaea.org/AMBDAS/>
- [13] Various processes for atoms, ions and molecules (structure, photonic collisions, electron collisions, atomic and molecular collisions, <http://gaphyor.lppp.u-psud.fr/>
- [14] Oak Ridge National Laboratory's - Controlled Fusion Atomic Data Center, <http://www-cfadc.phy.ornl.gov/bibliography/search.html>
- [15] GENIE - A General Internet Search Engine for Atomic Data, <http://www-amdis.iaea.org/GENIE/>
- [16] DANSE - Atomic and Molecular Bibliographic Data Search Engine, <http://www-amdis.iaea.org/DANSE/>
- [17] ICAMDATA - International Conference on Atomic and Molecular Data, <http://physics.nist.gov/Divisions/Div842/Icamdata/Homepage/icamdata.html>
- [18] Electron Impact Cross Section Calculations Using The Average Approximation, <http://www-amdis.iaea.org/AAEXCITE>
- [19] Effective ionization and recombination rate coefficients, <http://www-amdis.iaea.org/RATES>
- [20] Processing Standards Publication 184 "Integration Definition for Information Modeling (IDEF1X)", (1993) December 21. NIST, U.S.A