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Data Mining for Homeland
Security*

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TERRORISM INFORMATICS

Knowledge Management and Data Mining for Homeland Security

edited by

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PREFACE

Terrorism informatics is defined as the application of advanced methodologies and information fusion and analysis techniques to acquire, integrate, process, analyze, and manage the diversity of terrorism-related information for national/international and homeland security-related applications. These techniques are derived from disciplines such as computer science, informatics, statistics, mathematics, linguistics, social sciences, and public policy. Because the study of terrorism involves copious amounts of information from multiple sources, data types, and languages, information fusion and analysis techniques such as data mining, data integration, language translation technologies, and image and video processing are playing key roles in the future prevention, detection, and remediation of terrorism¹. Within the homeland security industry, information fusion is defined as the use of computer technology to acquire data from many sources, integrate this data into usable and accessible forms, and interpret the results². Although there has been substantial investment and research in the application of computer technology to terrorism, much of the literature in this emerging area is fragmented and often narrowly focused within specific domains such as engineering, computer science, computer security, information systems, knowledge management, and biomedicine.

The goal of this edited volume is to present an interdisciplinary and understandable review of terrorism informatics work for homeland security along two dimensions: methodological issues in terrorism research, including information infusion techniques to support terrorism prevention, detection, and response; and legal, social, privacy, and data confidentiality challenges and approaches.

SCOPE AND ORGANIZATION

This book has been grouped into two units. Unit I focuses on the methodological issues in terrorism research including trends, achievements and failures in terrorism research, methodological challenges in terrorism, challenges in retrieving and sharing terrorism information resources, and root causes of terrorism and the implications for terrorism informatics. It

¹ National Research Council, 2003. Making the Nation Safer: the Roles of Science and Technology in Countering Terrorism, p11.

² Ibid, p. 166.

also attends to critical socio-technical topics relevant to information and knowledge management such as privacy, data confidentiality, and legal challenges. Unit I chapters address the following topics and concepts:

- Mapping the domain of terrorism research
- Identifying key terrorism researchers
- The impact on 9/11 on terrorism
- Primary sources for the study of terrorism
- Analyzing the root causes of terrorism
- The construction of information resources useful for the study of terrorism
- Threat assessment and analysis
- Methods to support counterterrorism
- Data mining and privacy concerns

Unit 2 presents current research, including case studies, on the application of terrorism informatics techniques (such as web mining, social network analysis, and multimodal event extraction and analysis) to the terrorism phenomenon. Unit 2 focuses on three major areas of terrorism research: prevention, detection, and response as identified by the National Research Council³ and the U.S. White House's Office of Science and Technology Program (OSTP).⁴ Unit III will present the critical sociotechnical topics relevant to information and knowledge management: social, privacy, data confidentiality, and legal challenges.

- Examining "Jihad" on the world wide web
- Comparing extremist groups websites across regions
- Analyzing extremist communications as manifested in web forums
- Terrorist analysis systems and detection
- Identification of potential bioterrorist weapons
- Detecting and analyzing anomalous content
- Examining "insider" threats
- Using web mining and social network analysis
- Video analysis and deception detection
- Situational awareness technologies for disaster response

³ Ibid., p. 167.

⁴ Zahn, M.A. and Strom, K.J., 2004, "Terrorism and the Federal Social Science Research Agenda". Edited by M. Deflem. In *Terrorism and Counter-Terrorism: Criminological Perspectives*. Elsevier p112.

CHAPTER STRUCTURE

Each chapter follows a consistent structure to ensure uniformity and ease of use:

- Title
- Authors and affiliations
- Introduction: introduces the relevance and significance of the topic
- Literature review/Overview of the field: a systematic review of related works in the topic area
- Case study/Methods/Examples: One or two detailed studies or examples of selected techniques, systems, implementations and evaluations
- Conclusion and discussion
- Acknowledgements
- References and notes
- Suggested readings
- Online resources
- Questions for discussion

The work is further enhanced by author and subject indexes at the back of the book, intended to facilitate ease of access to the contents./

INTENDED AUDIENCE

The audience of the book is intentionally broad. It is intended to bring useful knowledge to scientists, security professionals, counterterrorism experts, and policy makers. It is also intended to serve as reference material and as a textbook in graduate-level courses related to information security, information policy, information assurance, information systems, terrorism, and public policy. Readers will learn new concepts, technologies, and practices developed in terrorism informatics through the comprehensive reviews of recent work and detailed case studies presented in each chapter. Students and researchers will broaden their understanding and knowledge in these new research topics. Practitioners will be able to better evaluate and/or employ new and alternative technologies for their current projects and future work.

EDITOR BIOGRAPHIES

Dr. Hsinchun Chen is McClelland Professor of Management Information Systems at the University of Arizona and Andersen Consulting Professor of the Year (1999). He received the B.S. degree from the National Chiao-Tung University in Taiwan, the MBA degree from SUNY Buffalo, and the Ph.D. degree in Information Systems from the New York University. Dr. Chen is a Fellow of IEEE and AAAS. He received the IEEE Computer Society 2006 Technical Achievement Award. He is the author/editor of 15 books, 17 book chapters, and more than 150 SCI journal articles covering intelligence analysis, biomedical informatics, data/text/web mining, digital library, knowledge management, and Web computing. His recent books include: *Intelligence and Security Informatics for International Security: Information Sharing and Data Mining*, and *Digital Government: E-Government Research, Case Studies, and Implementation* (Springer).

Dr. Chen was ranked eighth in publication productivity in Information Systems (CAIS 2005) and first in Digital Library research (IP&M 2005) in two recent bibliometric studies. He serves on ten editorial boards including: *ACM Transactions on Information System*; *ACM Journal on Educational Resources in Computing*; *IEEE Transactions on Intelligent Transportation Systems*; *IEEE Transactions on Systems, Man, and Cybernetics*; *Journal of the American Society for Information Science and Technology*; *Decision Support Systems*; and *International Journal on Digital Library*. Dr. Chen has served as a Scientific Counselor/Advisor to the National Library of Medicine (USA), Academia Sinica (Taiwan), and the National Library of China (China). He has been an advisor for major NSF, DOJ, NLM, DOD, DHS, and other international research programs in digital government, national security research, medical informatics, and digital library. Dr. Chen is the founding director of the Artificial Intelligence Lab and Hoffman E-Commerce Lab. The UA Artificial Intelligence Lab, which houses 25+ researchers, has received more than \$20M in research funding from NSF, NIH, NLM, DOD, DOJ, CIA, DHS, and other agencies over the past 17 years. Dr. Chen is the (founding) conference co-chair of the IEEE International Conferences on Intelligence and Security Informatics (ISI) 2003-2007. The ISI conference, which has been sponsored by NSF, CIA, DHS, and NIJ, has become the premiere meeting for international and homeland security IT research. Dr. Chen's COPLINK system, which has been quoted as a national model for public safety information sharing and analysis, has been adopted in more than 550 jurisdictions nation-wide. COPLINK research had been featured in the *New York Times*, *Newsweek*, *Los Angeles Times*, *Washington Post*, *Boston Globe*, and ABC News,

among others. The COPLINK project was selected as a finalist by the prestigious International Association of Chiefs of Police (IACP)/Motorola 2003 Weaver Seavey Award for Quality in Law Enforcement in 2003. COPLINK research has recently been expanded to border protection (BorderSafe), disease and bioagent surveillance (BioPortal), and terrorism informatics research (Dark Web), funded by NSF, CIA, and DHS. In collaboration with Customs and Border Protection (CBP), the BorderSafe project develops criminal network analysis and vehicle association mining research for border-crosser risk assessment. The BioPortal system supports interactive geospatial analysis and visualization, chief complaint classification, and phylogenetic analysis for public health and biodefense. In collaboration with selected international terrorism research centers and intelligence agencies, the Dark Web project has generated one of the largest databases in the world about extremist/terrorist-generated Internet contents (web sites, forums, and multimedia documents). Dark Web research supports link analysis, content analysis, web metrics analysis, multimedia analysis, sentiment analysis, and authorship analysis of international terrorism content. The project has been featured in the Associated Press, Fox News, National Public Radio (NPR), the British Broadcasting Corporation (BBC), the NSF Press, *Discover Magazine*, the *Arizona Republic*, and the *Toronto Star*, among others. Dr. Chen is the founder of the Knowledge Computing Corporation, a university spin-off company and a market leader in law enforcement and intelligence information sharing and data mining. Dr. Chen has also received numerous awards in information technology and knowledge management education and research including: AT&T Foundation Award, SAP Award, the Andersen Consulting Professor of the Year Award, the University of Arizona Technology Innovation Award, and the National Chaio-Tung University Distinguished Alumnus Award.

Dr. Edna Reid is an Associate Professor at Clarion University, Pennsylvania. Formerly, she was a senior research scientist and project manager in the Artificial Intelligence Laboratory at the University of Arizona, Tucson. She was an Associate Professor with Nanyang Business School, NTU, Singapore, and the president of the Society of Competitive Intelligence Professionals Singapore (SCIP Sgp). Formerly, she was an entrepreneur with an Internet start-up in Malaysia. In 1993, she joined the Division of Information Studies, NTU. Prior to going to Asia, Edna was at the School of Communication, Information and Library Studies, Rutgers University. In 1990, she was a postdoctoral researcher at the University of California, Berkeley, where she conducted research in terrorism information services. She also served as a senior systems analyst and data analyst team

leader at private enterprises in both Germany and northern Virginia in the U.S.. She has analytical and library sciences experience in the intelligence community. Her areas of specialization include competitive intelligence, web mining, and terrorism informatics. Her research focuses on web mining of extremist groups' digital artifacts (e.g., web sites, forums, multimedia). She has published in a number of journals, conference proceedings, and edited collections. She received a Certificate in Management Information Systems (MIS) from American University in 1984, and the DLS (Library Science) degree from the University of Southern California in 1983. She also holds a bachelors degree in Education from D.C. Teachers College and a Masters Degree in library science from the University of Maryland.

Dr. Joshua Sinai is a Program Manager for counter-terrorism studies & education at The Analysis Corporation (TAC) (www.theanalysiscorp.com), in McLean, VA. His government contracts range from a project to map the worldwide landscape of terrorism & counterterrorism studies to an assessment of tribalism in Iraq. He also assists in developing curriculum on counterterrorism analysis to TACLearn, TAC's internal distance learning educational program. Prior to joining TAC in June 2006, Dr. Sinai worked at Logos Technologies and ANSER (Analytical Services), from which for 18 months he was seconded to function as a government official in the Science & Technology Directorate, Department of Homeland Security, where he managed a project on the social and behavioral components of terrorism and its impact on society. As part of his duties, he co-chaired an interagency working group, under the White House Office of Science & Technology Policy, on how the social, behavioral and economic sciences can contribute to counterterrorism, which produced a report on this subject in April 2005. He also contributed to the formulation of the announcement for proposals to create the DHS center on terrorism studies and served on the evaluation committee to review all proposals. Dr. Sinai's publications include chapters in edited academic volumes, national security journals, and his column on Terrorism Books appears regularly in the Washington Times' book review section. He has also published newspaper articles on terrorists' use of the Internet and how the special operations community approaches counterterrorism. He is a frequent presenter at academic conferences on terrorism & counterterrorism. Dr. Sinai can be reached at: jsinai@theanalysiscorp.com.

Dr. Andrew Silke currently holds a Chair in Criminology at the University of East London where he is the Programme Director for Terrorism Studies. He has a background in forensic psychology and has worked both in academia and for government. His research and writings are

published extensively in academic journals, books and the popular press. He is the author of over 100 articles and papers on subjects relating to terrorism, and has given numerous papers and invited lectures on these topics at conferences and universities across the world. In recent years, he has worked with a wide range of scientific, government and law enforcement agencies, including the U.S. Federal Bureau of Investigation, the United States Department of Justice, the United States Department of Homeland Security, NATO, the United States National Academy of Sciences, the Royal Society, the United Nations, the European Defence Agency, the European Commission, the Metropolitan Police and the House of Commons. He has also provided risk assessment and acted as an expert witness in several terrorism-related cases. Professor Silke serves by invitation on both the European Commission's Expert Group on Violent Radicalisation, and the United Nations Roster of Terrorism Experts. He is an Honorary Senior Research Associate of the renowned Centre for the Study of Terrorism and Political Violence at the University of St Andrews and is a Fellow of the University of Leicester. His work has taken him to Northern Ireland, the Middle East and Latin America.

Dr. Boaz Ganor is the associate dean of the Lauder School of Government, the founder and executive director of the International Policy Institute for Counter-Terrorism (ICT), and the head of the Homeland Security Studies program (Graduate degree, Executive program and Bachelor specialization) at the Interdisciplinary Center Herzliya, Israel. He is also the founder and Chairman of the International Counter Terrorism Academic Community (ICTAC). In addition, Dr. Ganor is a senior fellow of MIPT (The Memorial Institute for Prevention of Terrorism, Oklahoma City, USA) and a member of the International Advisory Council of the International Centre for Political Violence and Terrorism Research at the Institute of Defense and Strategic Studies (IDSS), Nanyang Technological University, The Republic of Singapore. Dr. Ganor is also a member of the board of directors of ICSR – The International Centre for the Study of Radicalization and Political Violence (a partnership of the University of Pennsylvania (U.S.A.), the Interdisciplinary Center (Israel), King's College (London, U.K.), and The Jordanian Institute of Diplomacy). Past positions for Dr. Ganor have included membership in the Israeli Delegation to the Trilateral (American-Palestinian-Israeli) Committee for Monitoring Incitement to Violence and Terrorism as well as the Israeli National Committee for Homeland Security Technologies. He has served as an advisor on counter-terrorism topics to the Israeli Ministry of Defense, the Israeli Counter-Terrorism Coordinator in the Prime Minister's office, Israel National Security Council, and the Israeli Transportation Ministry during

the peace talks with Jordan. In addition, he advised Prime Minister Benjamin Netanyahu on his book *Fighting Terrorism*. Dr. Ganor has been widely published and some of his key works have included *Israel's Counter-Terrorism Strategy – Efficacy versus Liberal–Democratic Values* (Political Science, The Hebrew University, Jerusalem, Israel, 2002), and *Terrorism and Public Opinion in Israel* (Tel-Aviv University, Israel, 1989). In addition, Dr. Ganor has written numerous articles on the topic of terrorism and counterterrorism. His latest book, *The Counter-Terrorism Puzzle – A guide for decision makers* (Transaction Publishers, 2005), is currently being used as a textbook in several universities. Dr. Ganor is also the editor of *Trends in International Terrorism* (2007), *Hypermedia Seduction for Terrorist Recruiting* (2007), and *Post Modern Terrorism* (2005).

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Ronald Eguchi is President and CEO of ImageCat, Inc., a risk management company specializing in the development and use of advanced technologies for risk assessment and reduction. Mr. Eguchi has over 30 years of experience in risk analysis and risk management studies. He has directed major research and application studies in these areas for government agencies and private industry. He currently serves on several Editorial Boards including the *Natural Hazards Review* published by the American Society of Civil Engineers and the Natural Hazards Research and Applications Information Center, University of Colorado, and the *Journal on Uncertainties in Engineering Mechanics* published by Resonance Publications, Inc. He is also a past member of the Editorial Board of the Earthquake Engineering Research Institute's *JOURNAL SPECTRA*. He is a past member of the Scientific Advisory Committee of the U.S. Geological Survey, a committee that reports to Congress on recommended research directions for the USGS in the area of earthquake hazard reduction. In 1997, he was awarded the ASCE C. Martin Duke Award for his contributions to the area of lifeline earthquake engineering. He still remains active in the ASCE Technical Council on Lifeline Earthquake Engineering serving on several committees and having chaired the Council's Executive Committee in 1991. In 1992, Mr. Eguchi was asked to chair a panel, established jointly by the Federal Emergency Management Agency and the National Institute of Standards and Technology, to develop a plan for assembling and adopting seismic design standards for public and private lifelines in the U.S. This effort has led to the formation of the American Lifeline Alliance, currently managed by the National Institute of Building Sciences. Mr. Eguchi currently serves on MCEER's (Multidisciplinary Center for Earthquake Engineering Research) Research Committee for Transportation Research. He is a member of the National Research Council's Disaster Roundtable. He is also a charter member of the Mayor's

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From Terrorism: Accounts of Disengagement from Radical and Extremist Movements will be published by Routledge in 2008. It contains detailed first hand interviews he has conducted with members of 13 terrorist movements. Dr. Horgan is regularly invited to speak to a variety of government, police, and military audiences around the world, and since 2005, he has been a member of the European Commission Expert Group on Violent Radicalisation.

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Brian A. Jackson is associate director of RAND's Homeland Security research program. His terrorism-focused research has examined tactical and operational learning by terrorist groups, terrorist groups' use of technology, projects developing approaches to assess the threat posed by potential terrorist use of specific weapons technologies, examination of the strategies to respond to terrorist targeting of national economies, development of terrorist attack scenarios to support policy analysis efforts, and a large-scale study emergency responder protection during responses to major disasters and terrorist attacks. Key publications in these areas include articles in *Studies in Conflict and Terrorism* and *Military Review* on technology adoption by terrorist organizations, terrorist organizational structures and behavior, and intelligence gathering for targeting terrorist and insurgent groups, as well as the RAND reports *Aptitude for Destruction, Volumes 1 & 2*, examining organizational learning in terrorist groups, *Breaching the Fortress Wall: Understanding Terrorist Efforts to Overcome Defensive Technologies*, and Volumes 1 and 3 of the RAND *Protecting Emergency Responders* series of publications. Brian holds a Ph.D. in bioinorganic chemistry from the California Institute of Technology and a Master's degree from George Washington University in Science, Technology, and Public