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A novel risk assessment and optimisation model for a multi-objective network security countermeasure selection problem

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### Abstract

Budget cuts and the high demand in strengthening the security of computer systems and services constitute a challenge. Poor system knowledge and inappropriate selection of security measures may lead to unexpected financial and data losses. This paper proposes a novel Risk Assessment and Optimisation Model (RAOM) to solve a security countermeasure selection problem, where variables such as financial cost and risk may affect a final decision. A Multi-Objective Tabu Search (MOTS) algorithm has been developed to construct an efficient frontier of non-dominated solutions, which can satisfy organisational security needs in a cost-effective manner.

### Highlights

 We develop a model to support financial investment decisions.  We propose a

multi-objective countermeasure selection problem. We find trade-offs between cost and risk. A MOTS method has been developed to find near optimal solutions. Experiments demonstrate good performance in terms of quality of solutions.



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## Keywords

Financial decision support; Risk assessment; Countermeasure selection problem; Multi-objective optimisation; Tabu search

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**Valentina Viduto** is a doctoral student in the Institute for Research in Applicable Computing (IRAC) at the University of Bedfordshire. She obtained her BSc (Hons) in Computer Networking in 2009. The same year, she has been accepted as a PhD student

on the project funded by EPSRC investigating multi-objective decision support in computer security, risk assessment and optimisation techniques. Her research interests include information security, multi-objective optimisation, visualisation techniques, decision support and risk management.

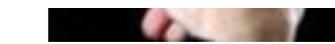


**Prof. Carsten Maple** is the Pro Vice Chancellor for Research & Enterprise at the University of Bedfordshire responsible for developing the University's strategy for research and enterprise activities. He is a member of several professional societies including Council of Professors and Heads of Computing whose remit is to promote public education in Computing. Also, he is a Fellow of the British Computer Society, the Chartered Institute for IT and is a Chartered IT professional. His interests include information security and trust, and authentication in distributed systems, cyberstalking.



**Dr. Wei Huang** obtained his BSc and MSc from South China University of Technology and completed his PhD at Loughborough University, where his research was focused upon the scheduling of batch processing plants including development of a constraint model and computer-based scheduling system.





**Dr. David López-Pérez** David Lopez-Perez is Research Associate at the Centre for Telecommunication Research, King's College London, UK. David received his Bachelor (BSc) and Master (MSc) degrees in Telecommunication from Miguel Hernandez University, Spain, in 2003 and 2006, respectively, and his Doctor in Philosophy (PhD) title from University of Bedfordshire, UK, in 2011. He has been invited researcher at DOCOMO USA labs, Palo Alto, CA in 2011, and CITI INSA, Lyon, France in 2009. In May 2007, he was awarded with a PhD Marie-Curie fellowship at the Centre for Wireless Network Design (CWIND) at University of Bedfordshire, UK. With 30 years of age, he has published more than 50 book chapters, journal and conference papers in recognised venues, and has been awarded as Exemplary Reviewer for IEEE Communications Letters. From February 2006 and for a year, he was with Cork Institute of Technology, Ireland, and from February 2005 and for a year, he was with VODAFONE Spain, Spain. He is or has been guest editor of ACM Springer Mobile Networks and Applications (MONE) Journal and EURASIP Journal of Computer Networks and Communications (JCNC), and editor and/or author of several cellular HetNet related books, i.e. "Heterogeneous Cellular Networks: Theory, Simulation and Deployment" Cambridge University Press, 2012, "Femtocells" Technologies and Deployment, Wiley 2010, and "Femtocell Networks: Deployment, PHY Techniques, and Resource Management", Cambridge University Press, 2012. Moreover, he is or has also been co-chair of several HetNet related workshops, e.g., the 1st IEEE WCNC Workshop on Broadband Femtocells: Paving the way to HetNets, the 2nd IEEE 2011 GLOBECOM Workshop on Femtocell Networks (FEMnet).

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