

Using the D-Wave2X Quantum Computer to Explore the Formation of Global Terrorist Networks

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Proposed Work

We propose to explore the feasibility of using the D-Wave2X quantum computer to study the transformation of isolated radical individuals into terrorist cells, and their potential to transition into larger, interconnected networks that commit violent collective actions. This is an important problem in achieving an understanding of how terrorist threats evolve. Models for the evolution of terrorist social networks begin with a subpopulation of individuals having radical beliefs and consider how affinities between like-minded individuals modify the local and global structure of the network¹. Why some networks culminate solely in the formation of isolated radical cells, while others link up to form widespread terrorist organizations, is a critical question for global security.

While some models use agent-based approaches to study terrorist network formation, others use combinatorial optimization to explore general principals whereby social networks may form coherent, long-range social structures in which an overall balance is achieved between affinities and conflicts among individuals and groups. Recent authors have explored the analogy between this global optimization problem and computing the ground state of an Ising spin glass². This is especially intriguing since this is the class of optimization problems for which the D-Wave computer seems to offer a real computational advantage over using modern optimization libraries on conventional computers³. It is this avenue we wish to explore in considering the critical question posed above.

Staffing

John Ambrosiano (PI) is a computational scientist with the Information Systems and Modeling group at Los Alamos National Laboratory. He received his Ph.D. in Physics from The College of William and Mary in 1980. His experience in computational science is broad, with particular emphasis on models of complex systems, data science, and decision analysis. His role will be to contribute to the design and implementation of modeling methods and systems, and to coordinate the effort overall.

Benjamin Sims (Co-PI) is a sociologist with the Statistical Sciences Group at Los Alamos National Laboratory with background in qualitative and quantitative social science. He has a Ph.D. in Sociology and Science Studies from the University of California, San Diego. His current research focuses on human interactions with computing and infrastructure systems, with particular focus on scientific computing and cyber security. He will provide critical subject matter expertise.

Randy Roberts (Co-I) is a computational scientist with the Information Systems and Modeling group at Los Alamos National Laboratory. He received his Ph.D. in Physics from the University of Texas, Austin in 1993. His computational experience covers many areas of computational science and modeling. His experience in quantum physics includes Ising models in the mean field approximation and Boltzmann lattices. He will have a key role in helping the team exploit quantum systems analogies in using of the D-Wave computer to the best advantage within the context of the proposed exploration.

Budget

Investigator	Z-Number	Hours	Cost
Ambrosiano	119751	60	\$8,940
Roberts	117884	60	\$7,440
Sims	175820	60	\$6,720
Total Budget			\$23,100

¹ M. Genkin and A. Gutfraind, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1031521

² G. Facchetti et al, PNAS, vol. 108, no. 52, pp. 20953–20958, 2011

³ C. Coffrin, <https://youtu.be/uEsfVAVd5ks> and private communication.