

GERGANA BOUNOVA

gergana at alum.mit.edu

POSITIONS

| | |
|---|-------------|
| Associate Specialist, UC Berkeley, Department of Statistics | 8/2010-2011 |
| Postdoctoral Associate, MIT Engineering Systems Division | 2011 |
| Postdoctoral Associate, MIT Aeronautics and Astronautics | 4/2009-2010 |
| Research Assistant, MIT Space Systems Lab, Aeronautics and Astronautics | 2003-2009 |
| Stagier, European Space Agency Human Spaceflight and Microgravity Directorate | 2005 |

EDUCATION

Massachusetts Institute of Technology

| | |
|--|---------------|
| PhD, Aeronautics and Astronautics, area: Aerospace Systems, minor: Systems Biology | 9/2005-2/2009 |
| Master of Science, Aeronautics and Astronautics, GPA 4.6 | 6/2003-2/2005 |
| Bachelor of Science, Aeronautics and Astronautics, GPA 4.9 | 1999-2003 |
| Bachelor of Science, Theoretical Mathematics, GPA 4.9 | 1999-2003 |

Institut Supérieur de l'Aéronautique et de l'Espace

| | |
|--|---------------|
| Exchange student, courses in aerodynamics, airplane dynamics and propulsion. | 2/2002-6/2002 |
|--|---------------|

Lester B. Pearson, United World College of the Pacific

| | |
|---|-----------|
| International Baccalaureate Diploma | 1997-1999 |
| Graduated first in a class of 100, with a maximum 45-points. Research essay on Diophantine equations. | |

SELECTED RESEARCH

| | |
|--|-----------|
| Genome surveillance by small RNA in Tetrahymena | 2010-2011 |
| Joint work with Elizabeth Purdom and Mary Couvillion. Tools: Python, R | |

| | |
|---|-------------|
| Management of Engineering Change | 4/2009-2010 |
|---|-------------|

Postdoctoral work, Strategic Engineering Group, Supervisor: Prof. Olivier de Weck
Analyzed historical and live change management data from five different billion-dollar offshore oil and gas projects by BP. Performed single-project and comparative analysis of change management, change impact on engineering design and on the organizational structure of the company. Produced two major technical reports with a posteriori analysis and recommendations for BP. Collaborative work with Dr. Afreen Siddiqi and the Cambridge Engineering Design Center. Tools: Python, Cytoscape.

| | |
|---|-------------|
| Network Modeling of Engineering Systems Evolution, | 2005-2/2009 |
|---|-------------|

PhD work, Strategic Engineering Group, Advisor: Prof. Olivier de Weck
Studied how complex engineering systems evolve by analyzing their history, particularly for applications that can be modeled as networks. This includes all US airlines in the period 1990-2007, with focus on JetBlue Airways and Southwest Airlines. Developed extensive Python and Matlab network analysis toolboxes, shared freely online. Tools: Python, Matlab, Pajek, NetDraw.

| | |
|---------------------------------------|-----------|
| Engineering Change Propagation | 2006-2007 |
|---------------------------------------|-----------|

Research Assistant, Strategic Engineering Group, Advisor: Prof. Olivier de Weck
Performed computational analysis for a MIT SDM thesis studying the documented engineering changes for a Raytheon radar system. Analyzed a 41000-change request dataset as a network and discovered that changes do not have a single source, but rather percolate from many smaller disconnected components to a large connected graph over many time steps. Work published in collaboration with colleagues from the Cambridge Engineering Design Center. Tools: Python.

Lunar Missions Architecting

5/2005-9/2005

Stagier, European Space Agency, Supervisor: Scott Hovland

Created a lunar space transportation network computational tool, which rapidly evaluates thousands of architectures down to vehicle design details level for human missions to the Moon. Architectures were evaluated with common metrics such as total mission launch mass and cost. Worked on integrating models with mission planning for the Concurrent Design Facility at ESTEC. Tools: Matlab, Excel, Excel server, **Object Process (Network) Modeling**.

Space Transportation Modeling

9/2004-4/2005

Research Assistant. MIT Space Systems Lab, PI: Prof. Crawley

Participated in a NASA-funded team study to determine the requirements for the Crew Exploration Vehicle and the specifications for a successful return mission to the Moon and a follow up campaign of human missions to Mars. Developed a rapid architecture evaluation interface tool between an architecture generator tool and vehicle evaluation models, as part of the space transportation systems and architecture optimization team. The tool was used in the core analysis and results provided to NASA. Tools: Matlab, Excel.

Large Telescope Arrays

2/2004-2/2005

Masters thesis, MIT Space Systems Lab, Advisor: Prof. Olivier de Weck

Created a multi-objective heuristic optimization framework to investigate a Pareto front of large telescope array configurations. Designed array configurations for minimum cost and maximum UV coverage with a focus staged deployment of array antennas in three discrete stages. Evaluated designs for robustness and extensibility. Tools: Matlab.

JOURNAL PUBLICATIONS

- Bounova, de Weck, *Overview of metrics and their correlation patterns for multiple-metric topology analysis on heterogeneous graph ensembles*, Phys. Rev. E 85, 016117 (2012)
- Siddiqi, Bounova, de Weck, Keller, Robinson, *A posteriori Design Change Analysis for Complex Engineering Projects*, Journal of Mechanical Design, October 2011, Volume 133, Issue 10, 101005
- Giffin, de Weck, Bounova, Keller, Eckert, Clarkson, *Change Propagation Analysis in Complex Technical Systems*, Journal of Mechanical Design, August 2009, 131 (8), 081010

CONFERENCE PROCEEDINGS

- Giffin M., de Weck O., Bounova G., Keller R., Eckert C., Clarkson J. *Change Propagation Analysis in Complex Technical Systems*, DETC2007-34652, ASME 2007, Design Engineering Technical Conferences, Las Vegas, NV, September 4-7, 2007
- Bounova, Hovland, de Weck, *Space Transportation Network Model for Rapid Lunar Architectures Exploration*, International Astronautical Congress, Valencia, Spain, Oct 2006
- Bounova, de Weck, *Augmented Network Model for Engineering System Design*, Proceedings of the International Conference on Complex Systems, 2006
- Bounova, Ahn, Hofstetter, Wooster, Hassan, de Weck, *Selection and Technology Evaluation of Moon/Mars Transportation Architectures*, Space 2005, Long Beach, California
- Bounova, de Weck, *Graph-theoretical Considerations in Design of Large Telescope Arrays for Robustness and Scalability*, 1st AIAA Multidisciplinary Design Optimization Specialist Conference, Austin, Texas, Apr, 2005
- de Weck O.L., Nadir W.D., Wong J.G., Bounova G. and Coffee T.M., *Modular Structures for Manned Space Exploration: The Truncated Octahedron as a Building Block*, AIAA-2005-2764, 1st Space Exploration Conference: Continuing the Voyage of Discovery, 30 Jan - 1 Feb 2005, Orlando, Florida
- Willcox, Bounova, *Mathematics in Engineering: Identifying, Enhancing and Linking the Implicit Mathematics Curriculum*, presented at ASEE Annual Conference, Salt Lake City, UT, June 2004

- Bounova, de Mierry, de Weck, *Search Algorithms for Space Tug Rendezvous: Simulation and Experiment*, 2004 IEEE Aerospace Conference, Paper # IEEEAC #1281, Big Sky, MT, March 6-13, 2004
- Galabova, Bounova, de Weck, Hastings, *Architecting a Family of Space Tugs Based on Orbital Mission Scenarios*, AIAA-2003-6368, AIAA Space 2003 Conference and Exhibition, Long Beach, California, 23-25 September 2003

THESES

- Bounova, *Topological evolution of networks: case studies in the US airlines and language Wikipedias*, MIT PhD Thesis, 2009
- Bounova, *Graph-theoretical consideration in the design of complex engineering systems for robustness and scalability*, MIT MS Thesis, 2005

REPORTS/WHITE PAPERS

- L Ariyo, NHM Caldwell, P J Clarkson, G Bounova, A Siddiqi, O L de Weck, R Keller, B Robinson, *The Management of Change (MoC) in Major Oil and Gas Exploration Projects at BP*, Final Report, 20th December 2010
- L Ariyo, NHM Caldwell, P J Clarkson, G Bounova, A Siddiqi, O L de Weck, R Keller, B Robinson, "The Management of Change (MOC) in Major Oil & Gas Exploration Projects at BP", Technical report S-EPT-052-10, BP, April 2010
- *Analysis and Optimization of Airline Networks: A Case Study of China* - Sante Fe Institute Summer School final paper, Beijing 2006, (presentation/poster)

PRESENTATIONS

- SERG Research Summit, June 1, 2011, *On network modeling tools, publishing your code and reproducible research*
- MIT ESD and NECSI Seminar, Mar 2011, *Phase Transitions and Early Growth of Language Wikipedia Networks*
- Mathworks, Natick MA, Apr 2010, *Networks in Matlab: how to represent and analyze systems as networks*
- UCL, Media Futures Group, Mar 2010, *Challenges in Modeling Real Systems as Networks*
- UC Davis, *Topological Evolution of Networks: case studies in US airlines and Wikipedia*
- Cambridge University, Engineering Design Center, Jun 2009, *Topological Evolution of Networks*
- MIT ESD Symposium, Jun 2009, *Network Representations and Analyses of Engineering Systems* with P. Bonnefoy
- Strategic Engineering Group, half-day hands-on seminar, May 2009, *Network Modeling Seminar: how to represent and analyze systems as networks*
- CSRI, Sandia National Labs, Feb 2009, *Topological Evolution of Networks: Case Studies in the US Airlines and Language Wikipedias*
- Engineering Systems Society Research Forum, ESD, *Networks, Topology, Evolution: Airlines and Wikipedia*, October 2008
- International Astronautical Congress, Valencia, Spain, October 2006, *Space Transportation Network Model for Rapid Lunar Architectures Exploration*
- International Conference on Complex Systems, Boston MA, 2006, *Augmented Network Model for Engineering System Design*
- ESD Advanced System Architecture class tutorial, February 2006, *Simple Network Analysis with Matlab*
- Space 2005, Long Beach, CA, 30 Sep - 1 Aug, 2005, *Selection and Technology Evaluation of Moon/Mars Transportation Architectures*

- European Space Agency, Noordwijk, the Netherlands, Aug 22, 2005, *Exploration Architectures Network Model*
- 1st AIAA Multidisciplinary Design Optimization Specialist Conference, Austin, TX, Apr 18-21, 2005, *Graph-theoretical Considerations in Design of Large Telescope Arrays for Robustness and Scalability*
- MIT Space Systems Laboratory Seminar, Jun 11, 2004, *Scalability and Robustness in Multiobjective Optimization of Large Telescope Arrays*
- 2004 IEEE Aerospace Conference, Big Sky, MT, Mar 6-13, 2004, *Search Algorithms for Space Tug Rendezvous: Simulation and Experiment*
- AIAA Region I Technical Mini-conference, Johns Hopkins Applied Physics Laboratory, MD, Oct 18, 2003, *Search Algorithms for Space Tug Rendezvous: Simulation and Experiment*

SOFTWARE

Matlab Tools for Network Analysis: A set of Matlab routines organized by functionality relevant for network theory applications. These routines are useful for someone who wants to start hands-on work with networks fairly quickly, explore simple graph statistics, distributions, simple visualization and compute common network theory metrics.

fastQ format data visual quality: Python script that produces color-coded quality plots based on fastq format read quality scores. Scores are averaged over binned read tile coordinates. Useful for spotting spatial quality patterns.

SELECTED ACTIVITIES

| | |
|--|---------------|
| RNA-Seq Workshop, Basic raw data quality control | 9/2011 |
| Organizer of the 2nd Cambridge-MIT Engineering Change Workshop | 10/2008 |
| MIT Portugal Program research assistant | 2007 |
| Santa Fe Institute visitor, Santa Fe, NM | 11/2007 |
| Santa Fe Institute Complex Systems summer school , Beijing, China | 6/2006 |
| New England Complex Systems Institute summer school | 6/2004 |
| aa-math project: evaluation of the mathematics curriculum for MIT aerospace engineering students | 2004 |
| Student advisor for incoming aerospace engineering students, MIT | 2003 |
| Junior high-school teacher of Java programming and web design, Pune, India | 6/2001-8/2001 |

AWARDS/RECOGNITION

| | |
|---|----------------|
| Amelia Earhart Fellowship, Zonta International | 2006, 2007 |
| Sigma Xi | 2005 |
| Joyce Warmkessel Graduate Fellowship, MIT | 2003-2004 |
| Phi Beta Kappa | 2003 |
| Ambassador of the MIT International Science and Technology Initiatives Program | 2002 |
| Honorably mentioned in the 60th William Lowell Putnam Mathematical Competition | 1999 |
| Scholarship for US Mathcamp 98, Toronto | 1998 |
| Third prize in Euclid Mathematical Competition in British Columbia | 1998 |
| United World Colleges Scholarship | 1997-1999 |
| Multiple top prizes in Bulgarian national mathematics Olympiads | 1995,1996,1997 |

LANGUAGES

Python, Matlab, R (current); Fortran, Java, Ada, Maple (past)
 (fluent) English, Bulgarian; (advanced) French, Spanish; (good) Italian, Russian

OTHER AFFILIATIONS

MIT Women's Volleyball Club
Berkeley Hang Gliding Club

Contact for full CV and references.

Last updated: February 20, 2012.