

## Alejandro Cornejo

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Google Inc.  
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- Interests** Distributed Computing, Distributed Robotics, Fault-Tolerance, Mobile Wireless Networks.
- Academics**
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|---|-------------|
| Harvard University, Cambridge MA<br>Postdoctoral Research Fellow.   | 2012 – 2014 |
| Massachusetts Institute of Technology, Cambridge, MA<br>PhD in Computer Science.  | 2007 – 2012 |
| Institute of Applied Mathematics and Systems (UNAM Mexico)<br>Master in Computer Science, with highest honors.  | 2005 – 2007 |
| Instituto Tecnológico de México (ITAM Mexico)<br>B. Eng. in Computer Engineering, with highest honors.<br>B. Eng. in Telematics Engineering, with highest honors. | 2001 – 2005 |
- Experience**
- Google Inc** *Software Engineer*  
Google Cloud  
Joined the google cloud networking team.  
January 2015 - present
- Oblong Industries** *Software Engineer*  
Mezzanine Team  
October 2014 - December 2015  
Worked on the main product team for Mezzanine, the core Oblong product, and the next generation tool for collaboration and infopresence. Specifically focused on the effort to change the architecture to allow mezzanine to be distributed across multiple machines in possibly disparate networks. Main challenge we overcame was to maintain near real-time performance without sacrificing consistency. Programming language being used most prominently is C++ together with the gspeak platform.
- Harvard University** *Postdoctoral Research Fellow*  
Radhika Nagpal  
September 2012 - Present  
Designed and developed a micro embedded operating system for the Kilobot platform to facilitate the development of distributed algorithms. I also designed various distributed localization algorithms for swarms of simple robots with distance-only sensing with different trade-offs between communication and computation. Some of this algorithms are currently being tested on the Kilobot platform. Developed the programming environment [kilobotics.com](http://kilobotics.com) geared towards people starting out with swarm robotics. Most recently I am investigating bio-inspired task-allocation algorithms for robot swarms.
- CSAIL (MIT)** *Research Assistant*  
Nancy Lynch  
September 2007 - October 2012  
My PhD research focused on local distributed algorithms for dynamic wireless networks and multi-robot systems. Some of the problems I worked on include: maintaining connectivity (or  $k$ -connectivity) of a robot swarm while allowing each robot to perform tasks independently; reliable and efficient computation with beeps (maximal independent set, coloring, etc); environment characterization for robotic exploration; prioritized information dissemination in vehicular networks; distributed localization of networks of simple robots (using only bearing sensors); failure detectors in asynchronous systems; aggregation in dynamic networks.

**Oracle**

Mark Dilman

*Intern*  
June 2011 - September 2011

Developed methodology and evaluation framework for workload management algorithms for the Oracle globally distributed database system. Designed various load balancing algorithms tailored for different configurations of the database system, and identified database performance metrics for optimal load balancing. This purpose of this work was to guide the design of new database load balancing algorithms for the Oracle platform.

**Institute of Mathematics (UNAM)**

Sergio Rajsbaum

*Research Assistant*  
July 2006 - August 2007

Theoretical distributed computing. I defined an enriched version of the iterative immediate snapshot model augmented with failure detectors. I analyzed the limits of problem solvability under the traditional notion of failures and provided alternative failure definitions that allow the extended iterative snapshot model to be as powerful as the asynchronous shared memory model with failure detectors.

**Microsoft Research**

Onur Mutlu

*Intern*  
January 2007 - April 2007

Designed and implemented an X86 performance multi-core simulator that includes pipeline details, out of order execution and a cache model that includes interconnection latencies and memory coherence. Implemented trace generation/reading tools to profile ordinary applications in the X86 performance simulation. This work was subsequently used as a platform for testing new memory architectures for the X86 platform.

**Cannes Laboratory**

Alfredo Weitzenfeld

*Research Assistant*  
August 2003 - August 2004

Extended the NSL (Neural Simulation Language) system execution to a distributed master-slave computer network, the master displays results and dispatches simulation and training work to the slaves. The core simulation component of NSL can be executed on embedded systems and the results can be visualized offline or online by a computer.

**Papalote Museo del Nino**

Children's Museum

*Independent Contractor*  
October 2003 - June 2005

Designed and implemented several interactive systems including the virtual tours (*Juega, Toca y Aprende* and *Nutricin*), which later became full expositions. Developed interactive 3D monkey character that imitates spectators, as well as the interactive educational game on nutrition (*Qu comes que adivinas?*).

**Neuroimaging Laboratory**

Mara Elena Algorri

*Research Assistant*  
August 2002 - November 2005

Developed calibration and 3d tracking algorithms for stereoscopic vision. Implemented an image segmentation algorithm for localizing objects based on shape and color. An inverse kinematics system for animating virtual characters. Worked on a reconstruction algorithm to recover polygonal surfaces from medical studies (CAT, MRI, etc).

**Publications**

Michael Rubenstein, Alejandro Cornejo, Radhika Nagpal, *Programmable self-assembly in a thousand-robot swarm*, Science, 2014

Runner-up for Science's "breakthrough of the year"

Alejandro Cornejo and Radhika Nagpal, *Distributed Range-Based Relative Localization of Robot Swarms*, Workshop on Algorithmic Foundations of Robotics (WAFR 2014) 2014.

Alejandro Cornejo, Anna R. Dornhaus, Nancy A. Lynch, Radhika Nagpal, *Task Allocation in Ant Colonies*, International Symposium on Distributed Computing (DISC 2014), 2014

Alejandro Cornejo, Andrew J. Lynch, Elizabeth Fudge, Siegfried Bilstein, Majid Khabbazzian and James McLurkin, *Scale-Free Coordinates for Multi-Robot Systems with Bearing-only Sensors*, International Journal on Robotics Research (IJRR 2013) 2013.

Alejandro Cornejo, Calvin C. Newport, Subha Gollakota, Jayanthi Rao, Thomas J. Giuli, *Prioritized gossip in vehicular networks*, Ad Hoc Networks 11(1): 397-409 (ADHOC 2013), 2013.

Yehuda Afek, Noga Alon, Ziv Bar-Joseph, Alejandro Cornejo, Bernhard Haeupler, Fabian Kuhn, *Beeping a maximal independent set*, Distributed Computing (DIST 2013), 2013.

Alejandro Cornejo and Andrew J. Lynch and Elizabeth Fudge and Siegfried Bilstein and Majid Khabbazzian and James McLurkin, *Scale-Free Coordinates for Multi-Robot Systems with Bearing-only Sensors*, Workshop on Algorithmic Foundations of Robotics (WAFR 2012) 2012.

Alejandro Cornejo, Seth Gilbert and Calvin Newport, *Aggregation in Dynamic Networks*, Symposium on Principles of Distributed Computing (PODC 2012) 2012.

Alejandro Cornejo, Nancy Lynch and Srikanth Sastry, *Asynchronous Failure Detectors*, Symposium on Principles of Distributed Computing (PODC 2012) 2012.

Mikhail Volkov, Alejandro Cornejo, Nancy Lynch, Daniela Rus. Environment Characterization for Non-Recontaminating Frontier-Based Robotic Exploration , International Conference on Principles and Practice of Multi-Agent Systems (PRIMA 2011), November 2011 [**Best Student Paper Award**].

Yehuda Afek, Noga Alon, Ziv Bar-Joseph, Alejandro Cornejo, Bernhard Haeupler, Fabian Kuhn. Beeping a Maximal Independent Set , International Symposium on Distributed Computing (DISC 2011), 2011 [**Invited for Distributed Computing Journal**].

Alejandro Cornejo and Nancy Lynch, *Reliably Detecting Connectivity Using Local Graph Traits*, International Conference On Principles Of Distributed Systems (OPODIS 2010), Deceember 2010.

Alejandro Cornejo and Calvin Newport, *Prioritized Gossip in Vehicular Networks* , Foundations of Mobile Computing (DIALM-POMC 2010), 2010 [**Invited to Ad-Hoc Networks Journal**].

Alejandro Cornejo, Saira Viqar and Jennifer Welch. *Reliable Neighbor Discovery for Mobile Ad-Hoc Networks*, Foundations of Mobile Computing (DIALM-POMC 2010), 2010 [**Invited to Ad-Hoc Networks Journal**].

Alejandro Cornejo and Nancy Lynch, *Fault Tolerance Through k-Connectivity*, International Conference on Robotics and Automation: Workshop on Network Science and Systems Issues in Multi-Robot Autonomy (ICRA 2010), 2010.

Alejandro Cornejo and Fabian Kuhn, *Deploying Wireless Networks with Beeps*, International Symposium on Distributed Computing (DISC 2009), 2009.

Alejandro Cornejo, Nancy Lynch, Saira Viqar, Jennifer Welch, *A Neighbor Discovery Service Using an Abstract MAC Layer*, Allerton Conference (Allerton 2009), 2009.

Alejandro Cornejo and Nancy Lynch, *Minimum Spanning Trees and Cone-Based Topology Control*, Symposium on Principles of Distributed Computing (PODC 2009), 2009.

Alejandro Cornejo, Ruy Ley-Wild, Fabian Kuhn and Nancy Lynch, *Keeping Mobile Robot Swarms Connected*, International Symposium on Distributed Computing (DISC 2009), 2009.

Alejandro Cornejo and Nancy Lynch, *Connectivity Service for Mobile Ad-Hoc Networks*, Self-Adaptive and Self-Organizing Systems (SASO 08): Spatial Computing Workshop, 2008 [**Best Student Paper Award at CSW08**].

Alejandro Cornejo, Sergio Rajsbaum, Michel Raynal and Corentin Travers, *Failure Detectors are Schedulers*, Symposium on Principles of Distributed Computing (PODC 2007), 2007.

Ramiro A. Prez, Alejandro Cornejo and Mara Elena Algorri, *Construction of Camera-Based Frameless System: Technical Details and Clinical Applications*, American Association of Neurological Surgeons (AANS 2006), 2006.

Alejandro Cornejo and Mara Elena Algorri, *Camera-Based 3D Motion Tracker for Interactive Computer Graphics Animation*, Research on Computing Science, 2004.

Alejandro Cornejo and Mara Elena Algorri, *Construction of a Frameless Camera-Based Stereotactic Neuronavigator*, International Conference of the IEEE Engineering in Medicine and Biology Society (IEMBC 2004), 2004.

## Working Manuscripts

Nils Napp, Alejandro Cornejo and Radhika Nagpal. *Scalable Calibration for Kilobot Swarms*, Manuscript.

Alejandro Cornejo, Calvin Newport and Micah Sherr. *Maximal Independent Sets In Byzantine Networks*, Manuscript.

Alejandro Cornejo and Mohsen Ghaffari. *Distributed Sampling and Estimation*, Manuscript.

## Awards and Honors

- Runner-up for Science's "breakthrough of the year" (<http://science.sciencemag.org/content/346/6216/1444.full>)
- Best Student Paper Award at PRIMA 2011
- Best Student Paper Award at CSW 2008
- Alfonso Caso Award 2008, UNAM
- Akamai Presidential Graduate Fellowship 2007, MIT
- Institute of Mathematics Fellowship 2006, UNAM
- Alumni Association Research Award for Computer Engineering 2006, ITAM.
- CONACyT Fellowship 2004-2006 (National Council of Science and Technology of Mexico)
- Best Thesis of Computer Engineering and Information Technology 2005, ANIEI
- Award to Academic Excellence in Computer Engineering 2004, ITAM
- Best GPAs of Telematics Engineering 2004, ITAM
- Best GPAs of Computer Engineering 2004, ITAM
- Mention in the University Robotics Contest 2002, UIA
- 3<sup>rd</sup> place in Latin American ACM Programming Contest finals 2002

## In the Media

Some of my research on robots and networks has drawn media interest. Here are a few interesting ones:

- The Guardian: Harvards 1,000 Kilobot swarm demonstrates the future of robotics
- Science: Heads up for the gathering robot swarm
- Nature: Researchers create 1,000-robot swarm
- Live Science: Robot 'Army' Can Swarm into 3D Formations
- Wired: Largest Robot Swarm Ever
- IEEE Spectrum: A Thousand Kilobots Self-Assemble Into Complex Shapes

- BBC: Thousand-strong robot swarm throws shapes, slowly
- MakeZine: Resistance is Futile: Harvards Kilobot Swarm Keeps Fellow Robots in Line
- CNET: Swarm of 1,000 Kilobots cooperates like an ant colony
- MIT News: Sharing data links in networks of cars
- NBC News: How future cars could share Internet access
- Gigaom: Big data meets the connected car: Researchers tackle the vehicular network
- MIT News: Cars as Traffic Sensors
- ACM TechNews: Cars as Traffic Sensors
- Cognoramus: The Math Behind Prioritizing
- Green Car Congress: New algorithm to allow Wi-Fi connected cars to share Internet connections

## Service

Foundations of Mobile Computing (FOMC), Program Committee 2013, 2014

International Conference on Robotics and Automation (ICRA), 2014

International Journal on Robotics Research (IJRR), 2012

International Symposium on DIStributed Computing (DISC), 2010, 2012, 2013

Symposium on Principles of Distributed Computing (PODC), 2009, 2011, 2012, 2013

International Colloquium on Automata, Languages and Programming (ICALP), 2012

International Conference on Distributed Computing and Networking (ICDCN), 2011

International Symposium on Algorithms and Experiments for Sensor Systems, Wireless Networks and Distributed Robotics (ALGOSENSORS), 2009, 2011

International Conference on Concurrency Theory (CONCUR), 2010

International Symposium on Distributed Autonomous Robotic Systems (DARS), 2010

International Conference on Intelligent Robots and Systems (IROS), 2011

Symposium on Parallelism in Algorithms and Architectures (SPAA), 2009

International Conference On Principles Of DIStributed Systems (OPODIS), 2008

International Symposium on Stabilization, Safety, and Security of Distributed Systems (SSS), 2010