RESEARCH

2010/2011

Annual Report

جامعة كارنيجي ميلون في قطر
Carnegie Mellon Qatar

Inspiring Innovation and Creativity

Research

Carnegie Mellon Qatar has made significant progress towards developing its research activities and capacity. The university will continue to nurture and grow opportunities for faculty members to build regionally relevant research programs in their areas of interest and expertise. These research programs fall within the following areas:

- Computing and Mathematics
- Information Systems
- Economics, Business and Social Systems
- Sustainability and the Environment
- Language Acquisition and Education
- Arabic Language and Culture
- Liberal Arts

In Carnegie Mellon's tradition of interdisciplinary research, the university continues to actively pursue opportunities for research collaboration with colleagues at other Education City branch campuses, Qatar University, Hamad Medical Corporation, and many academic institutions in the region and around the world, including Carnegie Mellon's home campus in the United States. Further, Carnegie Mellon faculty are actively reaching out to industry in Qatar and the region to develop collaborative programs in which industry can directly benefit from the university's research capacity, labs and expertise.

Research at Carnegie Mellon Qatar is funded by several research programs:

- Qatar National Research Fund (QNRF)
- National Priorities Research Program (NPRP)
- Young Scientist Research Program (YSRP)
- Undergraduate Research Experience Program (UREP)
- Carnegie Mellon Qatar's Seed Research Fund
- Industry

Currently Carnegie Mellon Qatar has been awarded 116 research projects totaling $33.9 million USD.

Qatar National Research Fund (QNRF)

Qatar National Research Fund (QNRF) is an initiative of Qatar Foundation for Education, Science and Community Development (Qatar Foundation), established by His Highness Sheikh Hamad Bin Khalifa Al-Thani, Emir of Qatar, and chaired by Her Highness Sheikha Moza bint Nasser. QNRF is the premiere funding agency for basic and applied research in Qatar.

National Priorities Research Program (NPRP)

Qatar National Research Fund's National Priorities Research Program continues to be a major source of funding. The university saw a significant increase in interest in the NPRP program for the fourth cycle of program awards, submitted in November 2010. Carnegie Mellon Qatar faculty submitted 40 proposals and were awarded the following 12 NPRP grants for a total of $11 million USD:

- Large-scale, Personal and Mobile Sensor Networks and their Applications in Qatar
  Vinay Kolar, Ph.D.

- Innovative Computing and Mobile Technology for Improving English Literacy Skills for Children and for Adults
  Mary Dias, Ph.D.

- Cooperative Robotic Boats for Monitoring Coastal and Flooded Areas
  Mary Dias, Ph.D.

- Improving Professional Communication Skills through an Online Tutorial
  Andreas Karatsolis, Ph.D.

- Usable Automated Data Inference for End-users
  Iliano Cervesato, Ph.D.

- Use of Novel Water Treatment Methods for Inland Desalination of Brackish Groundwater in Qatar
  Krishnapuram Karthikeyan, Ph.D.

- Improving Reading Skills in the Middle School Science Classroom
  Dudley Reynolds, Ph.D.

- Automatic Correction of Standard Arabic Text: Resource and System Development
  Majd Sakr, Ph.D.

- Plant Uptake of Pollutants of Emerging Concern During Use of Reclaimed Water in Greenhouse Hydroponic Systems
  Krishnapuram Karthikeyan, Ph.D.

- New Mathematical Models for the Large Strain Swelling Response of Biological Tissues
  Hasan Demirkoparan, Ph.D.

- Complex Material Response Described by Continuum Mechanics with a Deformation Gradient Product Decomposition that has Novel Hyperelastic Implications
  Hasan Demirkoparan, Ph.D.

- Advancing Arabic Language Learning in Qatar
  Zeinab Ibrahim, Ph.D.

Carnegie Mellon Qatar currently has 18 funded NPRP projects in progress from the first three cycles of program funding. Four of those 18 have been completed. These projects represent more than $14.7 million USD in awarded grants.

For a list of all NPRP grants funded in the first three award cycles, see Appendix D.

Young Scientist Research Experience Program (YSREP)

Three Carnegie Mellon Qatar junior faculty received funding through the Young Scientist Research Experience Program. This new program is intended to support the overarching goal of Qatar National Research Fund – to foster a research culture in Qatar. The YSREP grants will help build human capital in Qatar through supporting young scientists and funding research of interest to Qatar's National Priorities. During the first cycle of the YSREP, a total of six awards were granted, with Carnegie Mellon Qatar receiving three of them totaling $900,000.

- Expanding Arabic Wikipedia by Statistical Machine Translation
  Behrang Mohit, Ph.D.

- Visual SLAM using an Array of Cameras
  Peter Hansen, Ph.D.

- A Type-safe Programming Language to Build Safe and Secure Web Applications
  Thierry Sans, Ph.D.

Undergraduate Research Experience Program (UREP)

Carnegie Mellon Qatar faculty participate in QNRF's Undergraduate Research Experience Program (UREP). The UREP has been effective in encouraging students to get involved in research, and in supporting their work. The following four UREP projects were awarded and active during the 2010-2011 academic year.

- Effects of Emotional Arousal on Mathematical Learning
  Dale Winter, Ph.D., Angela Brunstein, Ph.D. (faculty) and Lulwa El-Matbouly (student)

- Understanding Complex Physiological Problems in Medical Education
  Angela Brunstein, Ph.D. (faculty), Anam Waheed and Youssef Francis (students)

- Information Flow and Strategic Decisions in Social Networks
  Dale Winter, Ph.D. (faculty) and Arash Enayati (student)

- Economic Impact of Integration of ICT in Qatar SMEs
  George White, Ph.D. (faculty) and Earnest Appiah (student)

Seed Research Projects

Carnegie Mellon Qatar's long-term faculty are eligible to compete for Seed Research Funds. Faculty members may apply for research grants of up to $200,000 to initiate and fund research projects in their area of expertise or to explore projects in new areas. Carnegie Mellon Qatar strongly encourages faculty to focus on research that is relevant to Qatar and the region. Many faculty choose to spread these funds across multiple projects. The Seed Research program continues to be an important tool for recruiting strong faculty to Carnegie Mellon Qatar and helping them build their research programs once they arrive.

The following statistics attest to the productivity of the Seed program. All figures are cumulative from the beginning of the program in 2004 through the end of calendar year 2010.

- 45 faculty supported
- 68 projects funded
- 97 collaborations with researchers from corporations, government agencies and other universities around the world
- 70 external grant proposals generated
- 26 of those have been funded

- 215 published papers, books and conference presentations

Active Seed Research projects are listed in Appendix E.

A Highlight of Ongoing Research Initiatives

Qatar Oil & Gas Robotics

Carnegie Mellon Qatar's Qri8 lab in collaboration with the National Robotics Engineering Center (NREC) has been exploring the use of robotics technology to improve safety and production in the oil and gas industry. The Qri8 lab, with funding from QNRF, is developing fundamental sensing technologies that utilize stereo visual odometry and mapping to improve the inspection capabilities of pipe robots and autonomous ground robots. The lab is actively building relationships with commercial partners to bring this technology into production and use.

Carnegie Mellon Qatar Air Quality Monitoring Station

Air quality is a growing issue in Qatar and the region. Due to the desert climate, coarse particulate matter levels are high. However, due to the huge increase in vehicular travel in Doha, levels of fine particulate matter are also increasing, as are ultrafine particles (UFP). A growing number of studies indicate a relationship between increasing fine particulate matter and increased respiratory problems, making it essential to obtain data on these pollutants.

The first air quality monitoring station (AQMS) in Qatar is being developed by Carnegie Mellon Qatar. Initially, this station will measure four pollutants and ambient weather conditions. This data will be made available on the website www.qatarairquality.org in near real-time so that it will benefit the public, academia, and industry. The website will also have an educational component.

CameraNets: Coverage, Networking and Storage Problems in Wireless Multimedia Sensor Networks

Technology advances in inexpensive network-cameras have transformed surveillance applications. Such camera networks are useful in Qatar for securing large oil and gas plants, maritime surveillance, and congestion-aware routing of vehicles. However, existing camera networks are constrained by the amount of human involvement as operators have to track interesting events by constantly observing several video streams and configuring many cameras. As the camera networks grow from tens to thousands of cameras, it is impractical to rely on constant human involvement to monitor large areas.

The CameraNets project aims to build a self-configuring and intelligent network of cameras that reduces human-intervention and allows the camera network to scale at resolutions that were not possible before.

Foreign Labor in Qatar: An Empirical Sociological Analysis

The purpose of this two-year project is to develop a detailed and empirical understanding of the problems and challenges faced by low-income foreign migrant laborers (or "guestworkers") in Qatar through a survey of 1,000 workers, follow-up interviews, and longitudinal interviews with 12 workers for two years. The data will be used in the production of deliverables specifically aimed at policymakers and scholars concerned with the governance and management of the large foreign populations at work in the Gulf.

The Human Language Technology (HLT) lab

Carnegie Mellon Qatar's Human Language Technology Laboratory, consisting of Prof. Kemal Oflazer and three post-doctoral researchers, is involved in research and educational activities on language processing. The researchers are conducting research on five projects, with funding from the QNRF and faculty Seed Funding, and they are collaborating with researchers from the Language Technologies Institute at Carnegie Mellon in Pittsburgh.

The research projects focus on:

- Development of core Arabic language processing technologies.
- Statistical machine translation (SMT) involving Arabic, including applying SMT to expand the Arabic Wikipedia.
- Mining for comparable text resources to train SMT systems for dialectal translation.
- Using syntax-to-morphology mapping for translation into morphologically complex languages.
- Developing advanced tools for access to English language content that employ natural language processing technologies under the hood.

Members of the lab also engage in educational activities for students and interested researchers at Carnegie Mellon Qatar and other institutions. The activities include seminars, workshops and formal courses on language technologies.

Institutional Review Board – Human Subjects
The mission of the IRB is to protect the rights and welfare of research subjects. To satisfy the requirements of the Qatar National Research Fund, Carnegie Mellon Qatar has established a local Institutional Review Board (IRB) according to the guidelines in place from the Supreme Council of Health. The IRB works collaboratively with the IRB at Carnegie Mellon's main campus in the United States and has started to review IRB applications for research projects at the Qatar campus. The IRB committee is composed of a diverse group of scientific and non-scientific members from within the Carnegie Mellon Qatar campus, as well as one off-campus board member. At the end of the 2010-2011 academic year, the following were members of Carnegie Mellon Qatar's IRB:

- Dudley Reynolds, Teaching Professor of English (Chair)
- Marco Ameduri, Assistant Dean for Student Affairs at Weil Cornell Medical College in Qatar
- Yonina Cooper, Associate Teaching Professor of Computer Science
- Hasan Demirkoparan, Assistant Professor of Mathematics
- Krishinapuram Karthikryan, Visiting Associate Professor of Civil and Environmental Engineering
- Selma Limam Mansar, Associate Teaching Professor of Information Systems
- Carol Miller, Research Business Manger
- Silvia Pessoa, Assistant Teaching Professor of English
- Alex Rojas-Pena, Assistant Teaching Professor of Statistics
- Majd Sakr, Assistant Dean for Research
- George White, Associate Teaching Professor of Business Administration

National Research Priorities Program grants awarded to Carnegie Mellon Qatar faculty

NPRP AWARDS		
Lead PI in Qatar	**NPRP**	**Title**
Cycle one awards		
Amal Al-Malki	NPP29-6-7-9	Images of Muslim Women in Translated Mideast Media Sources: A Content and Discourse Analysis
Majd Sakr	NPRP 29-6-7-24	Human - Robot Interaction in an Arabic Social and Cultural Setting
Bernardine Dias	NPRP 1-7-7-5	Automated Tools for Effective Team Coordination in Emergency Response
Bernardine Dias	NPRP 30-6-7-91	Enhanced Education for the Visually and Aurally Impaired Using Automated Tutors and Interactive Computer Games
Cycle two awards		
Alex Rojas Pena	NPRP 08-643-1-112	Automated Measurement of Galaxy Morphology
Brett Browning	NPRP 08-589-2-245	Non-Destructive Gas Pipeline Inspection Using Computer Vision
Khaled Harras	NPRP 08-562-1-095	Coverage, Networking, and Storage Problems in Wireless Multimedia Sensor Networks
Kemal Oflazer	NPRP 08-485-1-083	Improved Arabic Natural Language Processing through Semi supervised and Cross-Lingual Learning

Cycle three awards

Silvia Pessoa	NPRP 09-857-5-123	Transnational Labor Migration in Qatar: An Empirical Sociological Analysis
Kemal Oflazer	NPRP 09-1140-1-177	Learning from Comparable Corpora for Improved English-Arabic Statistical Machine Translation
Brett Browning	NPRP 09-980-2-380	Robust Localization and Mapping for Autonomous Gas Inspection Vehicles
Majd Sakr	NPRP 09-1116-1-172	Qloud: Towards a Cloud Computing Infrastructure in Qatar to Target Regional Scientific Applications
Majd Sakr	NPRP 09-1113-1-171	Towards Natural Multi-Cultural Human-Robot Interaction
Kemal Oflazer	NPRP 09-873-1-129	A Natural Language Processing-based Active and Interactive Platform for Accessing English Language Content and Advanced Language Learning
Iliano Cervesato	NPRP 09-1107-1-168	Effective Programming for Large Distributed Ensembles
Iliano Cervesato	NPRP 09-667-1-100	Effective Programming for Large Distributed Ensembles

Ongoing Seed Research Projects undertaken by Carnegie Mellon Qatar faculty

Principal Investigator	Area	Project Name
Computing & Mathematical Sciences		
Nael Abu-Ghazaleh	Computer Science	Exploiting Software Defined Radio for Efficient Wireless Network Protocols
Brett Browning	Computer Science	- Visual Mapping - Effective Learning by Demonstration - Open Source Robot Platform
Lynn Carter	Computer Science	Effective Software Engineering Documentation
Iliano Cervesato	Computer Science	Automated Analysis of Large Cryptographic Protocols
Yonina Cooper	Computer Science	ICTD in developing Regions/Impacts of Teaching Approaches on Learning/Developing Icons for Alice
Hasan Demirkoparan	Liberal Arts and Sciences	- Boundary Value Problems in Non Linear Elasticity when Solid Mechanics is Coupled with Other Effects. - Mathematical Modeling of Hyperelastic Materials Undergoing Swelling
Bernardine Dias	Computer Science	- Technology Education - Autonomous Coordination for Heterogeneous Teams - Technology for Enhancing Child Literacy - Assistive Technology

Khaled Harras	Computer Science	Integrating Multiple Parallel Networks to Enhance Delay Tolerant Networking Protocols
Kemal Oflazer	Computer Science	Exploiting Local Syntactic Structure for Statistical Machine Translation into Morphologically Complex Languages.
Alex Rojas	Liberal Arts and Sciences	Characterization of the Influence of Local Environment on Galaxy Evolution
Majd Sakr	Computer Science	- General Purpose Execution of Media Applications - Human-robot Interaction in an Arabic Setting - Qatar Cloud Computing Pilot Program

Information Systems

Ian Lacey	Information Systems	Exploration of the Concept of the Dynamic Web as a Global Knowledge Base
Divakran Liginlal	Information Systems	- Authentication, Regulation and Privacy - Emerging Technologies and Socio-Technical Issues - Computational and Cognitive Models of Decision Making and Problem Solving
Selma Limam Mansar	Information Systems	Best Practices in Business Process Management and Global Sourcing of IT
Dan Phelps	Information Systems	Perceived Environmental Uncertainty and its Affect on Managed Service Providers

Business, Economics, Political and Social Systems

Stephen Calabrese	Business Administration	- Welfare and Distributional Analyses of Public Fiscal Policy - The Political Economy of Legislature Districting
Jon Caulkins	Business Administration	Drug Policy Analysis
Mohamed Dobashi	Business Administration	- Yemen's Quest for Inclusion in GCC - Unleashing the Energy of Technology Entrepreneurship
Thomas Emerson	Business Administration	The Relative Contribution of Knowledge-Based Startup Companies to National Wealth Creation
John Gasper	Business Administration	Retrospective Voting and Democratic Accountability
Robert T. Monroe	Business Administration	- Going Mobile - Rethinking MIS Education for Business Administration Students
Patrick Sileo	Liberal Arts and Sciences	Strategic Sequencing in the Multi-party Agreements
George White	Business Administration	Voice-Activated Personal Telephony Assistant

Sustainability & the Environment

Rami ElSamahy	Liberal Arts and Sciences	Alternative Strategies for Sustainable Urban Design
Kelly Hutzell	Liberal Arts and Sciences	- Qatar's Urban Public Space: The Evolution and Analysis of the Built Environment - 4dDoha - Scene and Speculations from an Emerging City
Krishnapuram Karthikeyan	Liberal Arts and Sciences	Use of Novel Water Treatment Methods for Desalination of Brackish Groundwater in Qatar
Terry Murphy	Liberal Arts and Sciences	Air Quality Monitoring at Education City

Language Acquisition and Education

Dan Baumgart	Liberal Arts and Sciences	Scientific Popularizations
Kira A. Dreher	Liberal Arts and Sciences	- Argument Visualization Methods for First-year English Courses in Carnegie Mellon Qatar - Annotated Bibliography & Review of Composition Literature from 1995-2010
Erik Helin	Liberal Arts and Sciences	- Community Outreach & Professional Development of Local Language Teachers - Text Analysis of Students' Written and Oral Production
Andreas Karatsolis	Liberal Arts and Sciences	Kairion: A Rhetorical Approach to Academic Citation/Information Communication Technologies for Medication Adherence/Information Communication Technologies for Medication Adherence
Silvia Pessoa	Liberal Arts and Sciences	- Academic Writing Development among Carnegie Mellon-Qatar Students - Hazawi: Stories from the Center, the Margins, and in between
Dudley Reynolds	Liberal Arts and Sciences	Qatari English Corpora Construction

Arabic Culture and Language

Amal Al-Malki	Liberal Arts and Sciences	Language Hybridity Unveiling Herself before the English Reader: Images of Islamic Women in Translated Mideast Media Resoures
Zeinab Ibrahim	Liberal Arts and Sciences	Arabic Sociolinguistics and the Teaching of Arabic as a Foreign Language
Lansine Kaba	Liberal Arts and Sciences	Foundations of Arab-African Relations. A Research Project .
Benjamin Reilly	Liberal Arts and Sciences	- Arabic Language Acquisition - Natural Disasters Textbook Project - Arabic Docuscope Project - Arabic Environmental Project
Jeffrey S. Squires	Liberal Arts and Sciences	Lecture/Essay Project: Cross-Cultural Literary Analysis of Early-Modern English drama and Classical Arabic Poetry.

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