DIMACS Center
Rutgers University

DIMACS Reconnect 2004 Programs

Report

March 2005

The DIMACS Reconnect Program aims to reconnect to the mathematical sciences research enterprise faculty whose primary responsibility is teaching undergraduates. A leading expert introduces participants to a current research topic relevant to the classroom through a series of lectures. The participants are involved in writing materials useful in the classroom, with the possibility of following up by preparing these materials for publication in the DIMACS Educational Modules Series.

This program, organized primarily around summer conferences, offers the opportunity for junior faculty as well as mid-level and senior faculty to advance to research questions in a new area of the mathematical sciences. Participants also acquire materials and gain ideas for seminar presentations and for undergraduate research projects.

The Reconnect Program is also aimed at reconnecting faculty to the mathematical sciences research enterprise by involving them in a leading research center. There are opportunities to follow up after the summer conference by getting connected to DIMACS researchers and other DIMACS programs throughout the year.

The program features a "satellite" component whereby the programs run at DIMACS become the training ground for other college faculty to observe the program and subsequently run a similar program at their own institutions in the succeeding summer. There are currently seven institutions that have run or have agreed to run Satellite Reconnect programs: Salem State College and the Illinois Institute of Technology in summer 2003, Lafayette College and St. Mary's College in summer 2004, Montclair State University and Spelman College in summer 2005, and Morgan State University in summer 2006. The programs through summer 2005 are funded in the current grant and we have requested a supplement to give us enough funds for the summer 2006 program at Morgan State.

Ia. Participants from the 2004 program

Participants:

Lafayette College Program

Kumar Abhishek, Lehigh University
Zhongyuan Che, Penn State Beaver
Sally Cockburn, Hamilton College
Benjamin J. Coleman, Moravian College
Joseph Crobak, Lafayette College
Steven B. Horton, United States Military Academy
Kenneth Kalmanson, Montclair State University
Stephen Kelley, Lafayette College
Jeffrey T. Linderoth, Lehigh University
Jamiiru Luttamaguzi, Elizabeth City State University
Ashutosh Mahajan, Lehigh University
R. Bruce Mattingly, SUNY Cortland
Claudio Nogueira de Meneses, University of Florida
Ann E. Moskol, Rhode Island College
Arup Mukherjee, Montclair State University
Michael J. Pelsmajer, Illinois Institute of Technology
Cynthia Phillips, Sandia National Laboratories
Zachary Reiter, Lafayette College
Zhizhang Shen, Plymouth State University
Kay B. Somers, Moravian College
M. Erol Ulucakli, Lafayette College
Boting Yang, University of Regina

St. Mary's College Program

Roque Aquino Batulan, St. Paul University
Mirela Damian, Villanova University
James D. Factor, Marquette University
Robin Y. Flatland, Siena College
Julie Suzanna Glass, California State University, Hayward
Sarah J. Greenwald, Appalachian State University
Bruno Guerrieri, Florida A&M University
Ivaylo Ilinkin, Rhodes College
Barbara Knight Kaiser, Gustavus Adolphus College
Reva Kasman, Grand Valley State University
Jill McGowan, Howard University
Teresa Moore, Ithaca College
Hien Nguyen, Rowan University
Val Pinciu, Southern Connecticut State University
Brother L. Raphael, FSC, Saint Mary's College of California
Amanda Katherine Serenevy, Boston University
Don Shimamoto, Swarthmore College
Lynn Stauffer, Sonoma State University
Marcelo O. Sztainberg, Northeastern Illinois University
Boting Yang, University of Regina
Kathy Zhong, California State University, Sacramento

DIMACS (Rutgers University) Program

Atif Abueida, University of Dayton
Frederick Adkins, Indiana University of Pennsylvania
Nwojo Nnanna Agwu, Elizabeth City State University
Kavita Bhatia, University of Wisconsin
Zhongyuan Che, Penn State Beaver Campus
Pamela Cutter, Kalamazoo College
Mike Daven, Mount Saint Mary College
Mike Gargano, Pace University
Elizabeth T. Goode, Towson University
Lifang Hsu, LeMoyne College
Pai-Hsi Huang, Rutgers University
Brenda Latka, Lafayette College
Eileen Lee, Framingham State College
L. Carl Leinbach, Gettysburg College
Kah Loon Ng, National University of Singapore
Greta Pangborn, Saint Michael's College
Kristin Pfabe, Nebraska Wesleyan University
Joel Pitt, Georgian Court University
Paul Raff, Rutgers University
Lou Shapiro, Howard University
Robert Smyth, Georgian Court University
Wasin So, San Jose State University
Dina Sokol, Brooklyn Colege, CUNY
Jean Taylor, Rutgers University
Boting Yang, University of Regina

Organizers:

Lafayette College Program

Jonathan Berry, Lafayette College
Fred S. Roberts, DIMACS, Rutgers University
Christine Spassione, Reconnect Program Coordinator, DIMACS

St. Mary's College Program

Lidia Luquet, St. Mary's College
Fred S. Roberts, DIMACS, Rutgers University
Christine Spassione, Reconnect Program Coordinator, DIMACS

DIMACS (Rutgers University) Program

Rochelle Leibowitz, Wheaton College
Fred S. Roberts, DIMACS, Rutgers University
Christine Spassione, Reconnect Program Coordinator, DIMACS

Main Speakers:

Lafayette College Program

Cynthia Phillips, Sandia National Laboratories
Jeffrey Linderoth, Lehigh University

St. Mary's College Program

Joseph O'Rourke, Smith College

DIMACS (Rutgers University) Program

R. Ravi, Carnegie Mellon University

Guest Speakers:

St. Mary's College Program

Jane Sangwine-Yager, Saint Mary's College of California

DIMACS (Rutgers University) Program

Abdul-Aziz Yakubu, Howard University

2005 Satellite Reconnect

Organizers:

Montclair State University

Arup Mukherjee, Montclair State University

Spelman College

Fred Bowers, Spelman College
Asamoah Nkwanta, Morgan State University

Main Speakers:

Montclair State University

Donald G. Saari, Institute for Mathematical Behavioral Sciences, University of California, Irvine

Spelman College

Lawrence Shepp, Dept. of Statistics, Rutgers University
Martin Lindquist, Columbia University

Guest Speakers:

Montclair State University

Michael A. Jones, Department of Mathematical Sciences, Montclair State University

Consultants from Minority Institutions:

Abdul-Aziz Yakubu, Howard University

Ib. Participating Organizations

Rutgers, The State University of New Jersey, Princeton University, AT&T Labs – Research, Bell Labs, NEC Laboratories America, Telcordia Technologies, Illinois Institute of Technology, Salem State College, Lafayette College, St. Mary's College of California, Spelman College, Montclair State University.

II. Project Activities

During this year of the grant, we ran a summer 2004 program at DIMACS (Rutgers University) and two summer 2004 satellite Reconnect programs were held at Lafayette and St. Mary's. We followed up the summer 2002 and 2003 DIMACS (Rutgers) programs and the 2003 Satellite programs at Illinois Institute of Technology and Salem State College by staying in touch with the participants and helping them with the modules they started in summer 2002 and 2003. We worked with the organizers of summer 2005 satellite programs, "training" them and guiding them, and also worked with the organizers of the potential summer 2006 satellite program.

Reconnect Satellite Conference 2004: Lafayette College

Topic: Experimental Algorithmics, with a Focus on Branch and Bound for Discrete Optimization Problems

Main Speakers: Cynthia Phillips, Sandia National Laboratories and Jeffrey Linderoth, Lehigh University

Organizers:

Jonathan Berry, Lafayette College

Fred S. Roberts, DIMACS Rutgers University

Large instances of hard discrete mathematical problems must be addressed in practice. Often, the most likely avenue to an optimal solution, or even a good bounded solution, is integer programming. In this program the participants studied:

* The mathematical foundations of integer programming, including
  - review of linear programming,
  - IP formulation techniques,
  - polyhedral theory,
  - separation,
  - approximation algorithms.

* Some software systems that are used to develop integer programming solutions such as:
  - AMPL,
  - PICO, and
  - MINTO.

* Some basic applications of integer programming, such as scheduling and sensor placement.

* Experimental algorithmics, and specifically, fair comparisons of integer programming solutions.

Reconnect Satellite Conference 2004: St. Mary's College
Topic: Folding and Unfolding in Computational Geometry
Main Speaker: Joseph O'Rourke, Smith College
Organizers:
Lidia Luquet, St. Mary's College
Fred S. Roberts, DIMACS Rutgers University

The folding of flat material (e.g., paper or metal), and the unfolding of a surface in 3D to a planar state, are complementary processes of increasing importance at the nexus between pure mathematics and a variety of application areas. Folding one-dimensional (1D) "linkages" is a model for protein folding. Designing origami foldings of (2D) flat paper into the desired final folded shape is an ancient problem with recent advances. Unfolding a (3D) polyhedron to a non-overlapping piece is a first step in manufacturing objects by bending aluminum.

The lectures in this program covered the mathematical and algorithmic issues of folding and unfolding, touching upon application areas as appropriate. Five novel features of the material that was presented are:

- Most of the material is accessible with only high-school mathematics, much of the remainder is accessible to students who have been exposed to algorithm analysis, and only a fraction requires advanced mathematics or computer science training.
- The material has an immediate physical, nearly visceral appeal, as it involves thinking about material of common everyday experience (i.e., paper folding, or crushing boxes) in novel ways. Thus students can use their intuitions as firm bases (supplemented by model building) from which to jump into new areas.
- The topic has real-world practical applications, as indicated above, so it touches reality directly.
- The frontier is proximate: Students can, in a just an hour or two, so thoroughly grasp the issues that they can actively work on unsolved problems.
- Although the open problems are accessible, they seem to be deep, so that their pursuit will naturally draw students deeper into mathematics and computer science.

The lectures started with 1D linkages, paying particular attention to "locked linkages," which have a relation to protein folding. Next they explored 2D, in particular, computational origami, including the difficulty of folding a map and flattening a box. Lastly they explored unfolding 3D polyhedra to flat "nets," and the reverse process of folding polygons to polyhedra, an area with application to manufacturing. In all three areas the most prominent unsolved problems were highlighted.

There is room in these topics for both pure mathematical research, and pure computer science theory research, but the richest aspects lie at the junction between the two: Progress on the mathematical questions seems to demand computation, and algorithmic progress is impossible without geometric understanding. Participants who brought expertise in either area benefited from the cross exposure.

Reconnect Conference 2004: DIMACS (Rutgers University)
Topic: Integrating Information from Sequence and Evolution: An Introduction to Computational Biology
Main Speaker: R. Ravi, Carnegie Mellon University
Organizers:
Rochelle Leibowitz, Wheaton College
Fred S. Roberts, DIMACS Rutgers University

The field of computational biology has evolved in the past two decades as a scientific discipline in its own right with textbooks, college degrees and placement opportunities unique to it. This program covered material fundamental to this field that is accessible at the undergraduate level, with the aim of providing solid background and a glimpse of research avenues in this area. Much of this material could be incorporated into relevant courses in discrete mathematics and computer science at the undergraduate level providing both material to motivate fundamental concepts as well as exposing undergraduates to this potentially exciting career track.

The thrust of this Reconnect program was problems involving the integration of information from genetic sequences and evolutionary heritage. Each day of the week focused on one topic, with three lectures and a group problem solving session per day. Here are some details of the program:

Day 1: Sequence alignment and dynamic programming technique: (i) maximum score segment and 2-sequence alignment (ii) local versus global alignments, multiple sequences and objective functions (iii) gaps, affine penalties, parametric variants.

Day 2: Character-based methods for reconstructing phylogeny: (i) perfect phylogeny - the Boolean case (ii) general case and parsimony (iii) gene trees versus species trees.

Day 3: Distance-based methods for reconstructing phylogeny: (i) ultrametric and additive reconstruction algorithms (ii) finding closest fit evolutionary trees (iii) maximum likelihood method.

Day 4: Integrating alignments and phylogeny reconstruction: (i) tree alignment (ii) multiple sequence alignments via trees (iii) lawler's taxonomy of problems involving trees and alignment.

Day 5: Problems in SNP analysis: (i) haplotyping via perfect phylogeny (ii) blocks and their determination.

III. Project Findings

Although work on specific research projects is not a main goal of the Reconnect program, we do hope that some of the participants will be stimulated to return to research activity. We have some indication that this has indeed happened. A few examples are given below.

At the July 2004 Satellite Reconnect Conference at St. Mary's College, California, Joseph O'Rourke (Smith College) reconnected the participants to research in Folding and Unfolding in Computational Geometry, resulting in several ongoing collaborations. O'Rourke is working via email, conferences, and visits with seven Reconnect participants. Julie Glass (California State University, Hayward), Kathy Zhong (California State University, Sacramento), and O'Rourke proved that a 2-chain can interlock with a k-chain, a previously unsolved problem mentioned in O'Rourke's lectures. They wrote a paper on the proof, and were joined as coauthors by two other researchers (Stefan Langerman and Jack Snoeyink) whose ideas they extended. Mirela Damian (Villanova University), Robin Flatland (Siena College), Lynn Stauffer (Sonoma State University), Marcello Sztainberg (Northeastern Illinois University), and O'Rourke have been working on unfolding special classes of orthogonal polyhedra. This effort has spread beyond the participants, and led to a paper by Mirela Damian and Henk Meijer, as well as ongoing work between Damian, Flatland, Meijer, and two of O'Rourke's students. Val Pinciu (Southern Connecticut State University) and O'Rourke have a new proof of the best bound on the "Fewest Nets" problem, and they have ideas on how to improve the bound. This is remarkable evidence of reconnection of these people to active research!

Steve Horton (Mathematical Sciences, United States Military Academy, West Point), Claudio Meneses (Industrial and Systems Engineering, University of Florida), Arup Mukherjee (Mathematical Sciences, Montclair State University), and Erol Ulucakli (Mechanical Engineering, Lafayette College) investigated the broadcast domination problem while participating in the DIMACS Satellite Reconnect program at Lafayette College in Easton, Pa., Summer 2004. Domination in graphs is a well-known and thoroughly studied subject. A dominating set S is a subset of the vertices in a graph such that every vertex in the graph is either in S or has a neighbor in S. The associated optimization problem is to find a dominating set of minimum cardinality. Broadcast domination is a variant of this problem that has not been widely studied. A nonnegative integer, the broadcast range, is associated with each vertex in S. A vertex v dominates all vertices in a path from v of length at most the broadcast range. The problem is to dominate every vertex in a graph using a minimum sum of broadcast ranges. The primary results of Horton, Meneses, Mukherjee, and Ulucakli were formulating the broadcast domination problem as a mixed integer program (MIP), and, for comparison, a purely binary integer program (BIP), solving a collection of instances of the broadcast domination problem using these formulations, and providing a comparison of the formulations from a computational standpoint. They solved the broadcast domination problem for fifteen different graphs, including random trees, random graphs, and a class of graphs for which it was unknown if there was an efficient algorithm using combinatorial methods. They observed that for the graphs they studied with at least 100 vertices, the MIP formulation was typically faster.

Jamiru Luttamaguzi (Elizabeth City State University), Michael Pelsmajer (Illinois Institute of Technology), Zhizhang Shen (Plymouth State Univerisity), and Boting Yang (University of Regina) were participants in the DIMACS Reconnect Satellite Conference 2004 at Lafayette College on "Experimental Algorithmics, with a Focus on Branch and Bound for Discrete Optimization Problems." Continuing the work that they began at the conference, Luttamaguzi, Pelsmajer, Shen, and Yang developed integer-programming solutions for several optimization problems in graph theory. In particular, they explored solutions to the space-filling problem, the bandwidth problem, and the cut-width problem by following the integer programming approach presented by Phillips and Linderoth at the Reconnect Conference. The space-filling problem is the problem of linearly ordering nodes in a mesh structure in such as way as to preserve the clusters in the mesh as much as possible. For example, a database can be thought of as a multi-dimensional space with each data record a node. How to partition the database into components for disk storage is an instance of the space-filling problem. Nodes that are close in the database space tend to be retrieved together, so one wants to keep neighboring data close in the partition. The bandwidth problem tries to label the vertices of a graph so that the maximum difference between adjacent vertices is minimized. For example, in VLSI design, you may want to arrange a set of circuit components (considered to be the vertices of the graph) on a circuit board so that the length of the longest wire is minimized. Another application is storing images when from each image there is a set of images we can reach, e.g. via hyperlinks. In order to minimize the time to search these images, we should arrange the linked images so that they are close to each other on the storage device. The cut-width problem deals with how to cut vertices among processors to both balance the load of the processors and minimize the inter-processor communication. Luttamaguzi, Pelsmajer, Shen, and Yang demonstrated several techniques in formulating an IP expression for these problems, coded each of the IP formula into an executable program, and ran the program on several instances.

The Reconnect 2003 conference held at DIMACS led to a research collaboration between Mike Gargano and Lorraine Lurie, both of Pace University. They developed a new hybrid method of classification based on self-ordering maps and swarm intelligence. Ants, bees, termites, and wasps are classified as social insects because they live in colonies. Every individual in a social insect colony seems to act independently of the others, but yet the colony functions as an organized unit. These social colonies can be thought of as natural problem solving systems (e.g., finding food, division of labor, building nests, and responding to a changing environment) having collective intelligence. Swarm intelligence emerges through the interactions among individual agents and also between the agents and their environment.

Since problem solving is an important aspect of computer science and related disciplines, these models are proving to be a powerful metaphor for artificially intelligent systems. In computer science a neural network is a mathematical model that mimics and abstracts the functioning of networks of nerves in humans and animals. Specifically, the **self-organizing map** model attempts to simulate unsupervised learning (that is, the network organizes itself) in classifying the data in a data file. The hybrid model introduced here has the visual appeal of swarm intelligence and the efficiency of a self-organizing map. They have continued this work, making presentations at Pace University. They submitted the paper "Swarm Intelligence, Self Organizing Maps, and a New Hybrid Method" to the Proceedings of the 35th Southeastern International Conference on Combinatorics, Graph Theory, and Computing.

IV. Project Training/Development

Training and career development were major goals of the program. See section on Human Resource Development for comments of faculty participants on the impact Reconnect had on their careers.

The Reconnect Conference at Lafayette also included several undergraduates. Here is what one of them had to say about his experience.

"My participation in the Reconnect was limited to my attendance at the talks. I had taken Math Modeling at the time, so I was able to understand the concept of Integer Programming… I was really interested by the concepts and the algorithms, so I enrolled in Linear Algebra while I studied in Ireland last fall. This spring, I'm taking Operations Research. I really enjoy it- I only wish that I had taken OR last spring so that I could have understood the talks a bit better. I'm also probably doing some Integer Programming applications with Dr. Liew of the CS department at Lafayette. I would say that the Reconnect program was very influential in my academic endeavors." Joe Crobak, undergraduate at Lafayette College, Lafayette-2004

One of the major goals of this project is to involve others in learning how to run such "reconnect" experiences. Many of our organizers have never run a conference or a summer program before and the first time is a real learning experience. Here is a comment from someone who has been involved in such a learning experience:

"Because of my participation in an earlier Reconnect Conference, I am assisting in organizing a Reconnect Conference on The Mathematics of Medical Imagining at Spelman College, an area of research which is related to my research interests. I hope to use this conference at Spelman to generate new interest in research in image processing at the College and create more interest in and opportunities for collaboration between the biomedical researchers on campus and the mathematics faculty. This is our goal for 2005." Sylvia T. Bozeman, Spelman College (2002)

V. Outreach Activities

Many of the activities that Reconnect participants have taken back to their campuses are of an outreach nature, involving interdisciplinary programs and seminars, with clubs, talks, etc. (See also the section on Human Resource Development and on Contributions within Discipline and the list of talks.) Here are some examples:

"I thought I'd tell you what I have been up to related to the Reconnect program. I have organized a team of faculty at my college, Framingham State College, to work with me to deliver a 4-part colloquium series for spring 2005. We will run these 1.5 hour colloquia in the evening and are targeting an amateur audience of undergrad students. In addition, we have invited teachers from local public schools to come too. In our first colloquium, we will have a panel discussion with 5 reps from biotech industry and local

universities to talk about grad school and career opportunities in this field. Then we will have a molecular biology talk, followed by a talk about nutrigenomics, and then phylogenetics. I was pleased that I obtained a budget of $1000 from my dean (unheard of at a state college!) to pay stipends and travel expenses for speakers, snacks, and books for our library. So far, so good...we are running the colloquia at a 4:30 time slot on the first Monday of the month and for both colloquia we had upwards of 50 in the audience/mostly students but some faculty and administrators." Eileen Lee, Framingham State College, DIMACS Reconnect 2004

A major emphasis in the project is to reach out to minority faculty and minority institutions. Each summer, we have had two observers from schools with a heavy minority enrollment. In summer 2004, this observer was Fred Bowers, Spelman College. In summer 2003, the observers were Ermelinda De La Vina, University of Houston-Downtown, and Yewande Olubummo, Spelman College. In summer 2002, the observers were Sylvia Bozeman, Spelman College, and Asamoah Nkwanta, Morgan State College. This aspect of the project has been highly successful. It led to Professor Bozeman asking if she could run a Reconnect program at Spelman. This was arranged for summer 2005 when the organizer of a satellite program scheduled for Oakland University moved to another university and took a dean's position. We replaced the Oakland program with a Spelman program. Professor Nkwanta has also asked if he could run a satellite program at Morgan State. We have submitted a request for supplement to our grant so as to work with him to develop such a program for summer 2006.

VI. Papers

Jonathan Berry, Daniel Hrozencik, Shrisha Rao and Zhizhang Shen, "Finding the median set of tree structures in synchronous distributed systems," **Proc. of the ISCA 19th International Conference on Computers and Their Applications**, 2005, accepted.

Jonathan Berry, Daniel Hrozencik, and Shrisha Rao, "Finding central sets in synchronous distributed systems," **Proceedings of the 19th International Conference on Computers and Their Applications. PPDCS-2004**, accepted.

Jie Chen, "Mathematics of auction theory, its application on ebay," in preparation.

Mirela Damian and Henk Meijer, "Grid edge-unfolding orthostacks with orthogonally convex slabs," **Proc. 14th Annual Fall Workshop on Computational Geometry**, MIT, Nov. 2004, pp. 20-21.

Mirela Damian, Robin Flatland, and Joseph O'Rourke, "Unfolding Manhattan towers," in preparation.

Michael L. Gargano and Lorraine L. Lurie, "Swarm intelligence, self organizing maps, and a new hybrid method," **Proceedings of the 35th Southeastern International Conference on Combinatorics, Graph Theory, and Computing**, submitted.

Michael L. Gargano and Lorraine L. Lurie, **"**A Hybrid Classification Model**," Proceedings of the 36th Southeastern International Conference on Combinatorics, Graph Theory, and Computing**, to be submitted.

Julie Glass, Stefan Langerman, Joseph O'Rourke, Jack Snoeyink, and Jianyuan K. Zhong, "A 2-chain can interlock with a k-chain," **Proc. 14th Annual Fall Workshop on Computational Geometry**, MIT, Nov. 2004, pp. 18-19.

Bruno Guerrieri, "Byers' algorithm applied to Voronoi diagrams on the sphere," in preparation.

Bruno Guerrieri, “Medial axis algorithm for 2D polygons,” in preparation.

Jamiru Luttamaguzi, Michael Pelsmajer, Zhizhang Shen, and Boting Yang, “Integer programming solutions for several optimization problems in graph theory,” P**roc. 20th Inter. Conf. on Computers and their applications**, 2005, accepted.

Jamiru Luttamaguzi, Michael Pelsmajer, Zhizhang Shen, and Boting Yang, “Integer programming solutions for several optimization problems in graph theory,” **DIMACS Technical Report 2005-02**, January 2005.

Martyn Mulder, Shrisha Rao, and K. Brooks Reid, “Another centrality concept on trees,” in preparation.

Mike Pelsmajer, Martyn Mulder, and K. Brooks Reid, “Axiomatics for the center function on trees,” in preparation.

Mike Pelsmajer, Martyn Mulder, and K. Brooks Reid, “Some new centrality concepts for trees,” in preparation.

Mike Pelsmajer, Martyn Mulder, and K. Brooks Reid, “Characterization of the center function, and some other centrality measures," in preparation.

Steven B. Horton, Claudio N. Meneses, Arup Mukherjee and M. Erol Ulucakli, “A computational study of the broadcast domination problem,” **DIMACS Technical Report 2004-45**.

Jamiru Luttamaguzi, Michael Pelsmajer, Zhizhang Shen and Boting Yang, “Integer programming methods for several optimization problems in graph theory,” **Proceedings of the 20th International Conference on Computers and Their Applications**, accepted.

Jamiru Luttamaguzi, Michael Pelsmajer, Zhizhang Shen and Boting Yang, “Integer programming methods for several optimization problems in graph theory,” **DIMACS Technical Report 2005-02**.

Zhizhang Shen, “Alleviation of the impact of the apex nodes in the pyramid structures,” **Applied Mathematics and Computation**, accepted.

VII. Other Products

Talks

Jon Berry, D. Hrozencik, , S. Rao, and Zhizhang Shen, “Finding the Median Set of Tree Structures in Synchronous Distributed Systems,” The ISCA 19th International Conference on Computers and Their Applications, March 16, 2005.

Mirela Damian and Henk Meijer, “Grid Edge-Unfolding Orthostacks with Orthogonally Convex Slabs,” 14th Annual Fall Workshop on Computational Geometry, MIT, November, 2004.

Robin Flatland, “Polyhedra Unfolding,” Union College, February 10, 2005.

Robin Flatland, “Polyhedra Unfolding,” Middlebury College, April 8, 2005.

Robin Flatland, “Polyhedra Unfolding,” Siena College, April 14, 2005.

Michael L. Gargano and Lorraine L. Lurie, “Swarm intelligence, self organizing maps, and a new hybrid method,” 35th Southeastern International Conference on Combinatorics, Graph Theory, and Computing, March, 2004.

Michael L. Gargano and Lorraine L. Lurie, **“**A Hybrid Classification Model**,”** 36th Southeastern International Conference on Combinatorics, Graph Theory, and Computing, March, 2005.

Julie Glass, Stefan Langerman, Joseph O'Rourke, Jack Snoeyink, and Jianyuan K. Zhong, “A 2-Chain Can Interlock with a k-Chain,” 14th Annual Fall Workshop on Computational Geometry, MIT, November, 2004.

Julie Glass and Jianyuan K. Zhong, “Interlocking and Locking in Linkages,” Math Monday Colloquium, St. Mary's College, Fall, 2005.

Bruno Guerrieri, “Topics in Computational Geometry Using Simple Calculus and Maple,” International Conference on Technology in Collegiate Mathematics, New Orleans, La., November, 2004.

Reva Kasman, “Why can't I fold a square into an icosahedron?” Department of Mathematics, Grand Valley State University, November, 2004.

Reva Kasman, “Why can't I fold a square into an icosahedron?” Department of Mathematics, Hope College, April 2005.

Lidia Luquet, " Art Gallery Theorems,” California Mathematics Council Junior Colleges Spring Conference at Lake Tahoe, May 10, 2003.

Lidia Luquet, "Geometry and Codes," Math Mondays Colloquium, Saint Mary's College, May 10, 2004.

Hong Liu, “An Application of Voronoi diagram and Delaunay Triangulations,” Kmax, Daytona Beach, Fla., March 21-25, 2005.

Lorraine L. Lurie, “Swarm intelligence, self organizing maps, and a new hybrid method,” Pace University, Fall, 2003.

Lorraine L. Lurie, “Swarm intelligence, self organizing maps, and a new hybrid method,” Pace University, Spring, 2004.

Jamiru Luttamaguzi, Michael Pelsmajer, Zhizhang Shen and Boting Yang, “Integer Programming Methods for Several Optimization Problems in Graph Theory. 20th Inter. Conf. on Computers and their applications, New Orleans, LA, March 16-18, 2005.

Ann Moskol, “Coding Theory: An Application of Mathematics for Your Classroom,” ATMNE Association of Teachers of Mathematics in New England, October 21-24, 2004.

Don Shimamoto, “The Topology Of Linkages: Visualizing Spaces Of Robot Arms, Polygons and other Graphs,” Math Monday Colloquium, St. Mary’s College, October 25, 2004.

Kay Somers, Title TBA, MAA's MathFest. Summer 2005.

Kay Somers, “Some Problems are NP-Harder Than Others”, Moravian College, Fall 2005.

Lynn Stauffer, “Folding and Unfolding in Computational Geometry: An Introduction,” Sonoma State University, March 2, 2005.

Lynn Stauffer, “Folding and Unfolding in Computational Geometry: An Introduction,” Math Monday Colloquium, St. Mary's College, May 2, 2005.

Lynn Stauffer, “Folding and Unfolding in Computational Geometry: An Introduction,” Santa Clara University, date to be determined.

Talks by students mentored by faculty who participated in Reconnect

Michele Fretta, “Modeling the Genetics of Language Trees,” Hudson River Undergraduate Mathematics Conference, 2005. Student of Greta Pangborn, St. Michael’s College, DIMACS Reconnect 2004.

Raymond Navarette, “Unfolding Polyhedra,” Williams College, April 30, 2005. Student of Robin Flatland, St. Mary’s Reconnect 2004.

Modules

The participants produced first drafts of classroom modules. Here is a list of topics and authors for each conference:

Lafayette College Program

Steve Horton, Claudio de Meneses, M. Erol Ulucakli and Arup Mukherjee
“An Integer Programming Approach to the Broadcast Domination Problem”

Kumar Abhishek and Ashutosh Mahajan
“Implementation of Primal Heuristics in Mixed Integer Programs”

Zhonguan Che, Ken Kalmanson and Ann Moskol
“Mixed Integer Programming for Undergraduates”

Boting Yang, Jamiiru Luttamaguzi, Michael Pelsmajer and Zhizhang Shen
“Solving Problems with Integer Programming”

Sally Cockburn, Ben Coleman, Bruce Mattingly and Kay Somers
“Some Problems are NP-Harder Than Others”

St. Mary's College Program

Mirela Damian, Robin Flatland, Lynn Stauffer and Marcelo Sztainberg
“Edge Unfolding of Polyhedra”

Ivaylo Ilinkin and Boting Yang
“Folding a Ruler: Is It Easy?”

Reva Kasman and Teresa Moore

"Folding Polygons to Polyhedra"

Julie Glass and Kathy Zhong
"Interlocking and Locking in Linkages"

Barbara Kaiser, Amanda Serenevy and Don Shimamoto
"Lang's Tree Algorithm for Origami Design"

James Factor and Hieu Nguyen
"Linkages as Applied to Protein Folding"

Sarah Greenwald, Jill McGowan and Val Pinciu
"Unfolding and Folding Polyhedra"

Bruno Guerrieri
"Voronoi Diagrams and Medial Axes"

DIMACS (Rutgers University) Program

Nwojo Nnanna Agwu, Pai-Hsi Huang, Wasin So and Boting Yang
"Algorithms for Finding Maximal Scoring Segment"

Frederick Adkins, Zhongyuan Che, Kristin Pfabe and Dina Sokol
"Finding Repeats within Strings"

Elizabeth Goode, Greta Pangborn, Joel Pitt and Robert Smyth
"Phylogenetic Trees"

Kavita Bhatia, Lifang Hsu and Eileen Lee
"Phylogenetic Trees from DNA Data using the UPGMA Method"

Pamela Cutter, L. Carl Leinbach and Kah Loon Ng
"Sequencing DNA Strands"

Lou Shapiro
"Some Applications of 2 x 2 Matrices to Population Growth Models"

Atif Abueida, Mike Daven and Paul Raff
"Ultrametrics"

Jean Taylor
"Using BLAST"

<u>Here is a list of modules from earlier Reconnect Conferences that are either being reviewed for consideration in the series or are currently being edited for the series.</u>

Illinois Institute of Technology Program (2003)

Atif Abueida, Mike Ackerman, Sul-Young Choi
"Centrality And Anti-Centrality In Trees"

Erin Boyer, Benjamin V. C. Collins, Mark A. Mills
"An Examination Of 2-Centers And 2-Medians Of Graphs"

DIMACS (Rutgers University) Program (2003)

Atif Abueida, Mike Daven, Dan Ilaria
"Motivational Examples For Introducing And Teaching Discrete Math"

DIMACS (Rutgers University) Program (2002)

Pallavi Jayawant, Martha Kosa, Christine Shannon
"Reconstructing Curves from Sample Data: Implementing Algorithms using Delaunay Triangulations"

Colleen Livingston, Sarah Hodges, Steve Morics (2002 participant no longer on module)
"Rehabilitating after a Forest Fire: Voronoi Diagrams and Scheduling Algorithms"

Here is a list of modules from earlier Reconnect Conferences that the writers would like to be considered in the future (once they have a better draft):

Salem State College Program (2003)

Steven Leonhardi, Jim Sauerberg, Lidia Luquet
"Reed Solomon Codes: An Application of Linear Algebra"

Illinois Institute of Technology Program (2003)

Jonathan Berry, Daniel Hrozencik, Shisha Rao, Zhizhang Shen
"Finding Central Sets in a Synchronous Distributed System"

Peter Christopher, Dawit Haile, Michael Pelsmajer, Shane Redmond
"Central Sets in Trees (Where is the 'Middle' of a Tree?)"

DIMACS (Rutgers University) Program (2003)

Charles Hamaker, Martha Kosa, Michael Olan
"Chord: A Case Study Utilizing Data Structures to Support Scalable P2P Internet Applications"

DIMACS (Rutgers University) Program (2002)

Michael Olan, Donal MacVeigh, Darren Narayan (no longer on module)
"Voronoi Diagrams and Delaunay Triangulations: Data Structures and Algorithms"

Websites

http://dimacs.rutgers.edu/reconnect/

Reports

Steven James and Carl Leinbach, "Report to the Johnson Center for Creative Teaching, Bio/CS – 251 Introduction to Bioinformatics," 2005.

VIII. Contributions within Discipline

The "discipline" of this project is computer science, broadly speaking, with related areas of the mathematical sciences and biomathematics. Most of the research results discussed were in the fields of discrete mathematics and theoretical computer science, broadly defined. While research results are a contribution of course, the main results that have come out of the program are lectures by participants back on their own campuses or at professional meetings, new courses or pieces of courses, undergraduate research projects, new seminar series, etc. These bring current research in computer science and related mathematics into the classroom and extra-classroom educational programs. The most important contribution to the disciplines of discrete math and theoretical computer science in particular, and to the discipline of mathematical sciences broadly speaking (including all areas of mathematics, computer science, operations research, statistics, etc.) and biomathemtics was the opening up of new horizons to some very dedicated college professors and, in turn, their students of all backgrounds.

"I participated in Reconnect at Lafayette College in summer 2004. Here are some things that I have done or am planning to do as a result of that experience:

-I am working with a group of three other colleagues from this workshop to polish a module that we will submit for publication on the DIMACS website.

-I will be giving a paper that will address work from the Reconnect workshop during an invited paper session at MAA's MathFest in summer 2005.

-I used some of the material as an exercise in my Operations Research undergraduate course this term.

-I plan to give a seminar talk on the material in our module to undergraduate students at my institution next fall.

-I enjoyed it so much that I am probably going to apply to attend another Reconnect workshop this summer." Kay Somers, Moravian College, 2004-Lafayette

"I also added in the material as I have learned in those workshops in my teaching of algorithm and computational theory related courses." Zhizhang Shen 2004-Lafayette

"Our conference group collaborated on several research ideas during the month of August/September. Although the work has not (yet) resulted in publication, it has been very exciting and energizing. I included examples from the conference of NP-Complete problems in Computational Geometry in my senior undergraduate course in Theory of Computation (Fall 2004). Students were particularly motivated by the examples, as they were able to build manipulatives to work with the problem issues. I am giving a lecture in the Sonoma State University Mathematics Department Colloquium on March 2, 2005. I intend to overview the field of Computational Geometry and to emphasize our group's work on Edge Unfolding of Polyhedra. Our group is currently working on our latest Module draft on Edge Unfolding of Polyhedra. We hope to submit the Module for publication in the DIMACS series." Lynn Stauffer, Sonoma State University, 2004 – St. Mary's

"Short Run: Given that I teach in an undergraduate department of mathematics with heavy teaching load every semester, attending the workshop was extremely beneficial because it delivered over a period of a week a well-organized body of ideas that were to act as seeds for future endeavors. In my case, I was interested in the topics of Voronoi diagrams and had done some research in this area prior to attending the workshop. My main contribution at the time was a Maple worksheet implementing an algorithm (not mine) for generating Voronoi diagrams in 2D. It ended up being posted at the Maplesoft site. This research had been developed in the context of a Research Experience for Undergraduates (REU) during the summer 2003, summer really being the only time I can develop a self-contained topic of interest. In

the summer of 2004, I was working on implementing the Voronoi algorithm on a sphere. I am now thinking of what I will be doing this summer 2005 and all my activities to come (I was hoping to get started during the regular academic year but teaching a new course in Combinatorics is not making this feasible) will directly stem from my July 2004 experience at St-Mary's. They are:

1) A DIMACS module that will cover Voronoi diagram algorithm/generation in 2D and on the surface of a sphere together with Medial Axis and Straight Skeleton algorithm/generation for polygons, these last two related topics directly stemming from the workshop.
2) Submission of 2 disseminating papers on these topics to two second-tier or third-tier journals.
3) Hopeful inclusion of the 2D sphere implementation and the Medial Axis implementation, using Maple, on their website.

Long Run: Our department has applied for a Master Program. This has been an ongoing affair over several years with a lot of "starts and stops" mainly due to the rather weak research present in the department. This deficiency is, little by little, being turned around and the workshop has and will continue to give me a good stand among the group of faculty interested in bringing the master program to fruition. Furthermore, the topic of Computational Geometry is making its appearance in more and more departments (of mathematics) and one of my goals is to, indeed, implement such a course at two levels first, as an elective in the undergraduate curriculum and second, as a core course in our Industrial Mathematics Master program to be." Bruno Guerrieri, St. Mary's - 2004

"In November of 2004, I presented a 50-minute seminar to my department (at Grand Valley State University). As a result of this, I have been invited to give a similar talk for the Mathematics Department colloquium at nearby Hope College in April 2005. Moreover, one of my own colleagues expressed an interest in reading with me over the summer. I worked with Teresa Moore of Ithaca College on an educational module, and we intend to ultimately submit this for publication to the DIMACS series. We made significant efforts in the late fall to get out draft to the stage that I could include it in my portfolio for contract renewal which was due December 1, 2004. We met up at the Joint AMS/MAA meetings in Atlanta to discuss what needs to happen next to bring the module up to a final and submittable draft…, we have every intention of continuing the collaboration over the summer when we both have the time to dedicate. This semester I have a junior level student reading one of Joseph O'Rourke's papers on the subject. Currently this is an informal arrangement, but my goal is to be working with a student on more formal research investigation by the summer of 2006." Reva Kasman, Grand Valley State University, 2004 – St. Mary's

"I will give a seminar (or a series depending on the interest) on the material from the reconnect conference to my colleagues later this spring or next fall. I have students in our sophomore seminar working on presenting some of the material this semester. I expect to have students doing undergraduate research in the area in the next few semesters. Reva Kasman and I continue to work on our module and hope to have it to DIMACS for review this semester." Teresa Moore, Ithaca College 2004 – St. Mary's

"As an immediate outcome of this program, I have ideas on how to incorporate some of this material into my existing courses. I was in a writing group with two new collaborators – Carl Leinbach, from Gettysburg College, and Kah Loon Ng, from Rutgers. The module we wrote was intended for an introductory cross-discipline course in bioinformatics. At Kalamazoo College, we do not yet have such a cross-discipline course, and it's not clear whether there is interest in creating one. Kalamazoo College has an HHMI grant for the development of bioinformatics modules for existing courses, so I have planned to write at least one, possibly two, such modules for our computer science courses. I can easily adapt our module from Reconnect to create a project in my data structures course, and a portion of our module would be appropriate to include in our algorithms course. Carl, Kah Loon, and I are working on our module to get it into the DIMACS series." Pamela Cutter, Kalamazoo College, DIMACS 2004

"I used two examples from last summer's workshop in my Data Structures class this past fall. At the start of the class I used the sequence of improved approaches for maximum scoring subsequence search to introduce the idea of algorithmic efficiency. The final algorithm also provided an opportunity to review recursion. The last week of the semester I covered algorithms for maximum parsimony trees which tied together a number of ideas and themes from the class. The students enjoyed these examples and said the scale of the biology problems provided strong motivation for the importance of algorithmic efficiency. I am still editing my course notes for parsimony trees and will submit these to DIMACS by the end of this month. This semester I am advising a student who is presenting a talk on maximum parsimony trees and language development at the Hudson River Undergraduate Mathematics Conference." Greta Pangborn, Saint Michael's College, DIMACS – 2004

We received a variety of other comments from participants about follow-up activities. Here are some examples that illustrate the continuing impact of Reconnect, even on those who participated in earlier years.

"Since Mike Gargano and I attended the Reconnect 03 workshop, we wrote a math research paper on SOM and Swarm intelligence-and developed a Hybrid model algorithm, which I presented in the Boca Raton Combinatorics Conference at FAU in Boca Raton in March of 2004 And at a Pace Math Seminar conference in the Fall of 2003 and Spring 2004 for the faculty and students at Pace University. In addition, I plan to use the clustering algorithm in an upcoming statistical consulting project. Mike uses the Som and Swarm Intelligence algorithms in his classes. As for my teaching at Pace, because I am so active doing research and doing presentations, I was given the job of running the math seminars. My students are effected because they look up to me as a role model, but are more motivated to do their math work. My students are achieving more than in other classes, and I have begun to get a following." Lorraine Lurie, Pace University, (2003 DIMACS)

"I used the materials that I learned in the workshop and directed an independent study course (MA499 of our University) for two semesters. I had three students in each semester. My students will give talks in the Embry-Riddle Undergraduate Research Conference (ERUMC) on April 9. This is the second year that we host the conference. It is supported by MAA … I am going to design and implement a course called Mathematical Modeling and Visualization for our new degree program in Computational Mathematics. This course will include a module of 6-9 class hours that teaches the applications of Voronoi diagram." Hong Liu, Embry-Riddle (DIMACS - 2002)

Last year Steve Morics, University of Redlands (2002 DIMACS program) wrote: "I teach a problem solving course during our May term. The content is optional; the point is the process, introducing mathematics to students as a process of experimentation, conjecture, and proof. I teach combinatorics, and include a large project component. I will offer a Voronoi diagrams project as an option to the students (along with Nim, a historical project, and a card-shuffling project)." Steve is continuing to use the ideas and materials that resulted from his participation. This year he wrote: "I will be using the module I wrote as a project in my Discrete Problem-Solving class again in May."

"My participation at the 2003 Reconnect workshop at Illinois Institute of Technology has been beneficial. In particular, the module that I helped to create was used in my Mathematical Modeling course here at Central College. It was an excellent topic to show my modeling students how graphs can be useful." Mark Mills, Central College 2003-IIT

IX. Contributions -- other Disciplines

A major area of emphasis in the Reconnect program is on applications of methods of computer science and, more generally, of the mathematical sciences, to other disciplines. The tone was set with the summer 2002 program on Voronoi diagrams and applications. The lectures by Scot Drysdale (Dartmouth College) emphasized applications to such areas as Archaeology and Anthropology, Astronomy, Biology, Ecology and Forestry, Cartography, Crystallography and Chemistry, Geography, Geology, Geometric Modeling, Marketing, Metallurgy, Meteorology, Pattern Recognition, Physiology, Robotics, and Zoology. The summer 2003 programs all had interdisciplinary components. The centrality topic at Illiniois Institute of Technology featured a major emphasis on facility location problems. The coding theory topic at Salem State is a fundamentally interdisciplinary one with connections to many disciplines in engineering, for example. The resource sharing protocols topic at DIMACS (Rutgers) dealt with applications such as Web TV and "small world" networks which arise in the social sciences, the biological sciences, etc. The program on computational biology at DIMACS (Rutgers) 2004 was interdisciplinary by its very nature. The experimental algorithmics topic at Lafayette included real-world discrete optimization problems arising in problems ranging from transportation to manufacturing. The folding and unfolding topic at St. Mary's included real-world materials applications. The summer 2005 programs will also have major interdisciplinary components. Donald G. Saari of the Institute for Mathematical Behavioral Sciences at UC Irvine will explore the mathematics of elections and decisions at the Montclair State Reconnect Conference. He will introduce "the mathematics of voting" to show how the muscle power of mathematics can resolve many complex issues in elections. Lawrence Shepp and Martin Lindquist will present the mathematics of medical imaging at Spelman College. Modern medicine depends on CAT scanners and MRI scanners for the diagnosis of brain tumors and other diseases and on functional MRI and PET scanners for determining normal metabolism. Each of these medical technologies relies on basic and elegant mathematics.

Not surprisingly, the emphasis on interdisciplinarity is reflected in some of the follow-up activities reported by Reconnect participants. Here are just a few examples:

"I cooperated with other faculty member in physical science and students on a project sponsored by Jefferson Lab. In that project, I helped identify an application of Voronoi diagram and Delaunay Triangulations in a histogram morphing algorithm. This result will be presented in a Kmax conference hosted in Daytona Beach in between March 21-25, 2005." Hong Liu, Embry-Riddle (DIMACS - 2002)

"I have been given the privilege to design my own course, and have joined hands with the learning community. I will be doing a joint course with the English dept Fall 2005. The course will involve math research and a research report. I am very excited about this, since not only my skills that I learned from Dimacs will be taught, but the collaboration with the English Department (the professor is a well know writer) will give the students the expertise they need in writing a good research paper. I owe Dimacs a big thank you for training me in pedagogy, and math research." Lorraine Lurie, Pace University, (2003 DIMACS)

"Next, as far as the effect of the workshop is concerned, it had an immediate effect at Gettysburg. Last Fall I team-taught a course entitled "Introduction to Bioinformatics" with a Molecular Biologist, Steve James. We had nine students in the course, 6 Biology Majors (4 juniors, 2 sophomores and 1 first year) and 3 CS Majors (all juniors). I used the material from the workshop to organize the course syllabus and also to present the material on sequence alignment and constructing Phylogenetic Trees. So the workshop was very important to the success of the course. Some typical student comments from our course evaluations are:

> 'This class was great. Bioinformatics should be a required course for Bio majors because of its relevance to cutting edge, real world applications/events'
> 'Pretty impressive for being a new course.'
> 'I learned some new biology and how to use CS tools'

'I really liked the interdisciplinary approach and felt that I really learned a lot'
The course was supported by the Johnson Center for Creative Teaching on our campus…" Carl Leinbach, Gettysburg College, 2004-DIMACS

In his **Report to the Johnson Center for Creative Teaching,** Carl Leinbach and his co-teacher Steven James describe the Introduction to Bioinformatics course as a first for Gettysburg College. "It is the first cooperative effort by the departments of Biology and Computer Science on a formal course which is relevant to each of the disciplines. It is a truly integrated course in the sense that each class required the expertise of both of the disciplines." **Report to the Johnson Center for Creative Teaching**

"In addition to working on materials for my own courses, I would like to continue with some bioinformatics research. At this point, I am still learning some of the biology background, and I think it will be beneficial to work with a biologist to understand what some of the important issues/questions are in this field. I have always been interested in the connections between math and computer science, and this gives me a completely new application to look into." Pamela Cutter, Kalamazoo College, DIMACS 2004

"This semester I am sitting in on the biology department's bioinformatics course. In the future we would like to increase the computer science department's role in the course, possibly having the students work on interdisciplinary biology/CS teams." Greta Pangborn, Saint Michael's College, DIMACS Reconnect August 2004

"I have attended the DIMACS Reconnect Conference at Lafayette College during the Summer of 2004. The topic of the meeting was Experimental Algorithmics with a Focus on Branch and Bound for Discrete Optimization Problems. I joined many mathematicians and computer scientist and two Ph.D. students of industrial engineering. The conference was well organized and the logistics were very good. I particularly liked the presentation by the fellow from Lehigh University Industrial Engineering Department. Considering the fact that I was the only mechanical engineering faculty in this seminar, I found it very useful and fruitful. My interest in optimization was the main reason for attending. I have learned a lot by listening to invited lectures and taking part in the discussions. At certain times, I needed to dig into the books to learn a few new ideas of discrete programming. Reconnect was fruitful in a sense of accomplishment: I met a group of individuals and bonded with them instantly. We formed a small group to investigate an interesting problem and eventually produced a report." Erol Ulucakli, Lafayette College, 2004 -Lafayette

X. Contributions -- Human Resource Development

A major emphasis in the project is to reach out to minority faculty and minority institutions. We expand on our efforts in this direction in the section on Outreach Activities.

The Reconnect program has already had an effect on the lives and careers of many participants. Here is a sample of feedback we got about this, starting with the comments from some of the lecturers and organizers.

"As you know, I taught a Reconnect program last summer. It was a tremendous success from my point of view. Quite a few, perhaps as many as half, got re-hooked on original research, and in fact I continue to work with five participants actively. With one group, two teachers at California teaching colleges whose Ph.D. research areas are somewhat abstruse mathematics, have now coauthored a paper with me. That paper has already appeared in a conference, and we are now working on the journal version. Another pair and I are working on a paper for an upcoming conference. I continue to correspond with about half of the original participants, and all feel it is ok to send me a question by email. There is no question in my mind

that this forum you've created really does work. What remains is the question of whether it is worthwhile (for me, emphatically yes, not for the advancement of science from the regenerated research, but for how their reconnection affects their teaching, and the modules), and how to fund it. I believe my group was more than 50% women… creating role models… this is *so* useful to the institutions from which they come…" Joseph O'Rourke, Smith College

"This is about the impact of Reconnect in satellite sites, an impact that goes beyond the individual participant. The satellite Reconnect program at SMC brought mathematical energy to our department. Three of our faculty participated in different capacities in the program (guest lecturer, participant, director) and there was a sense of celebration that extended through and beyond the department. We also followed up by inviting several participants to speak at our colloquium series, Math Mondays, and they are bringing a revitalizing influence; they come to a friendly place and we are eager to hear of their progress since last summer. One spoke last fall, as he was spending a sabbatical in Berkeley; another is due this spring and two will be speaking this coming fall. Each Reconnect conference I attended as a participant produced a colloquium lecture delivered at our departmental colloquium and a manuscript. The topics of the lectures (Mathematical Biology, Art Gallery Theorems, Projective Codes) had not appeared previously in our colloquium. One manuscript was published in the DIMACS module series, a draft of another one is being reviewed, a third one is almost done. In two regional lectures delivered to junior college faculty in successive years I urged them to introduce first mathematical aspects of biology, then art gallery theorems in their curriculum.

Regarding the impact in our curriculum, the following are direct consequences of Reconnect:
Our January Term courses are intense and experimental. I created the course "Life and the Environment Through Mathematical Models" and offered it twice. Our course "The Art and Practice of Mathematics" is designed for liberal arts majors. On successive years I introduced in this course Art Gallery Theorems and Binary Codes.

As for the effect of Reconnect on how I teach, I can say that I keep as a shining model the creative magic that Joseph O'Rourke brings to the classroom and have tried on occasion, and in some measure, to achieve a similar effect.

When experts start something new they usually do it well, and then better every time, and so it is with Reconnect. Where is the analysis of the evolution of the Reconnect method?" Lidia Luquet, Saint Mary's College

"I attended the Reconnect program at St. Mary's College in July 2004. It was a wonderful and enriching experience. Being at a small college whose primary mission is teaching, I had felt isolated in my research efforts. This conference put me in touch with people at similar institutions who are also interested in computational geometry research. Since the conference, I have continued to collaborate on polyhedra unfolding problems with several people from the workshop and Joe O'Rourke (the main speaker). Our work has advanced significantly over the past months, and we are hoping to submit a paper on it to the Canadian Conference on Computational Geometry this May. In February, I gave an undergraduate talk on this topic at Union College. I have two other undergraduate talks scheduled in April -- one at Middlebury College and one at my college (Siena). I also have an undergraduate student working on an independent study on polyhedra unfolding. He will be giving a talk on this work at the Hudson River Undergraduate Math Conference at Williams College in April. In addition, my Reconnect group has submitted a near final draft of our module on polyhedra unfolding. In the future, I hope to incorporate the module ideas into the algorithms course at Siena. I can't say enough good things about Joe O'Rourke who led the workshop. He is a brilliant researcher and such a fabulous teacher. Truly a great role model! Also, Lidia Luquet did a fabulous job organizing the workshop. She took great care of us while we were there, and kept us all on track!" Robin Flatland, Siena College, St. Mary's 2004

“My goal in attending the workshop was to find a new research area that would be more amenable to involving undergraduate students, and also to working on independently, since in my current department I do not have colleagues in my thesis research area. I feel that the workshop put me on the right path, and will likely have a significant impact on my mathematical research career… Overall, I have felt energized and excited by the workshop. For me the topic was ideal, and Joe O'Rourke was a phenomenal speaker and leader. It has been important to me to make a transition from my thesis work, and this workshop has helped me find a new direction.” Reva Kasman, Grand Valley State University, 2004 – St. Mary’s

“The St. Mary's Reconnect Conference has had a definite impact on my career, primarily on my research. Prior to the conference, I already had an interest in one-dimensional folding ("linkages"), and I had hoped that the conference would give me a better sense of the state of the art as well as introduce me to a broad range of related topics and open problems. In this regard, the conference was a complete success. I am now working on three specific research projects that were suggested directly by what happened at St. Mary's: one project on linkages, one on two-dimensional folding ("flat foldable origami"), and one on three-dimensional folding ("polyhedral folding"). As often happens, in the course of pursuing these problems, I ended up learning about connections to areas of mathematics that I knew nothing about, for instance, discrete Morse theory and image analysis. As a result of meeting Lidia Luquet at Reconnect, I was invited back to St. Mary's to give a undergraduate colloquium talk last October. I also had some casual e-mail correspondence for a couple of months with Joe O'Rourke about a section of his book (with Erik Demaine) on folding and unfolding. I have a paper on linkages coming out in the American Mathematical Monthly in April, though this work was done prior to the Reconnect Conference. I am on sabbatical leave during the current academic year and so have not yet given serious thought to incorporating the material from Reconnect into my teaching. This will likely happen in time.” Don Shimamoto, Swarthmore, 2004 – St. Mary’s

“The program last summer was very instrumental in helping me to make connections with other faculty members who have interests similar to mine. Teaching at a very small school, it’s difficult to find these connections on my own. I have found a number of new colleagues with whom I am excited to work, both with this new topic, as well as other topics. I hope the energy and direction created through this program will continue.” Pamela Cutter, Kalamazoo College, DIMACS 2004

“Please pass to Fred my gratitude for letting me get involved with the Reconnect program and DIMACS. We're sometimes a little isolated academically up here. I really value connections with the rest of the academic world.” Steven B. Horton, United States Military Academy. Lafayette 2004.

“First of all, I very much enjoyed learning the material that was in the Reconnect workshop I attended. This summer we (Pallavi Jayawant, Martha Kosa and I) submitted our module on implementing Voronoi Diagrams to DIMACS ... I have not continued any other research directly linked to the workshop. However, I did use part of the material in my algorithms class last year. I thought I would be teaching computer graphics this Fall and then the work on the crust algorithm would have been a natural follow up for a student project. However, the schedule has changed. I still think it is possible that some of this work will be useful in student projects -- it just hasn't so far.” Christine Shannon, Margaret V. Haggin Professor of Mathematics and Computer Science, Centre College, 2002

“In 2003 I attended the program at IIT. This resulted in a paper or two together with K.B.Reid and H.M.Mulder, although actually finishing the write-up and sending it off - it's not clear when it's going to happen. In 2004 I attended the program at Lafayette. I improved my knowledge of integer programming and practical hueristics for it, and my group produced a paper that was accepted by CATA 2005 and also appears as a technical report w/DIMACS.” Michael Pelsmajer, Illinois Institute of Technology, 2003 –IIT and 2004-Lafayette.

“I found last summer's Reconnect conference to be enormously beneficial, but perhaps in ways less tangible than you expect. I greatly enjoyed the insight it gave me to researchers at the frontiers of the field, both for my own intellectual enjoyment and so that I would have a better idea of how to prepare any students of mine who might want to continue in this area. I incorporated some of the ideas into my undergraduate courses, but many specifics were beyond their background. Although I had no independent study students this year, in future I plan to make substantial use of the various DIMACS modules available. I spent a good part of last summer working on the educational module my group undertook. This led me to learn some computational biology from some of my colleagues here at Hamilton College. I have also talked to my colleagues in mathematics and computer science in a general way about some of the advances I learned at the conference. I put my name on a list for giving colloquia at related institutions on the topic, but I have not been taken up on this offer. I wish I could give you some concrete citations but unfortunately I cannot. I hope that it is enough that I did feel tremendously “reconnected” to the research enterprise as a result of this conference, and I hope to participate in many more over the course of my career.” Sally Cockburn, Hamilton College, 2004-Lafayette.