

Modeling Forum

Results of the 1995 Mathematical Contest in Modeling

Frank Giordano, MCM Director
Department of Mathematical Sciences
United States Military Academy
West Point, NY 10996–1786

Introduction

A total of 320 teams of undergraduates, from 194 schools, spent the third weekend in February working on applied mathematics problems. They were part of the eleventh Mathematical Contest in Modeling (MCM). On Friday morning, the MCM faculty advisor opened a packet and presented each team of three students with a choice of one of two problems. After a weekend of hard work, typed solution papers were mailed to COMAP on Monday. Seven of the top papers appear in this issue of *The UMAP Journal*.

Results and winning papers from the first ten contests were published in special issues of *Mathematical Modeling* (1985–1987) and *The UMAP Journal* (1985–1994). The 1994 volume of *Tools for Teaching*, commemorating the tenth anniversary of the contest, contains all of the 20 problems used in the first ten years of the contest and a winning paper for each. Limited quantities of that volume and of the special MCM issues of the *Journal* for the last few years are available from COMAP.

Problem A: The Single Helix

The problem consists of assisting a small biotechnological company in designing, proving, programming, and testing a mathematical algorithm to locate “in real time” all the intersections of a helix and a plane in general positions in space (see **Figure 1**).

Similar programs for Computer Aided Geometric Design (CAGD) enable engineers to view a plane section of the object that they design, for example, an aircraft jet engine, an automobile suspension, or a medical device. Moreover, engineers may also display on the plane section such quantities as air flow, stress, or temperature, coded by colors or level curves. Furthermore,

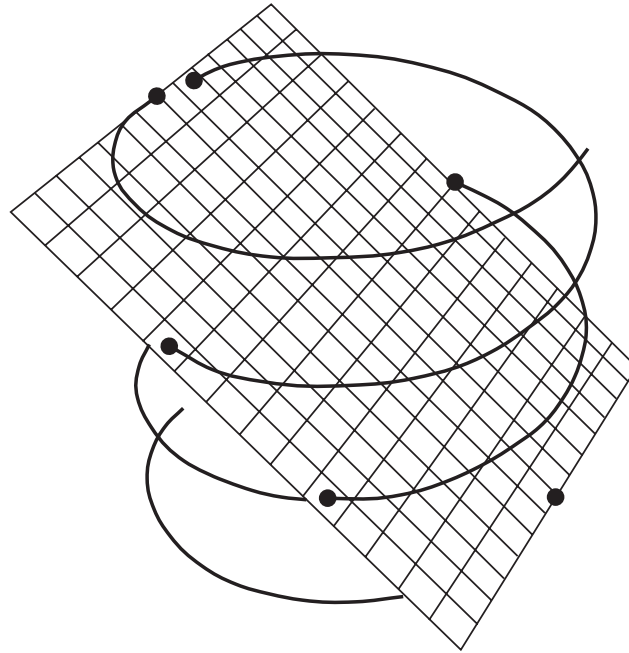


Figure 1. Some intersections of a helix with a plane.

engineers may rapidly sweep such plane sections through the entire object to gain a three-dimensional visualization of the object and its reactions to motion, forces, or heat. To achieve such results, the computer programs must locate all the intersections of the viewed plane and every part of the designed object with sufficient speed and accuracy. General “equation solvers” may in principle compute such intersections; but for specific problems, special methods may prove faster and more accurate than general methods. In particular, general software for Computer Aided Geometric Design may prove too slow to complete computations in real time, or too large to fit in the finished medical devices being developed by the company. The considerations just explained have led the company to the following problem.

Problem: Design, justify, program, and test a method to compute all the intersections of a plane and a helix in general positions (at any locations and with any orientations) in space.

A segment of the helix may represent, for example, a helicoidal suspension spring or a piece of tubing in a chemical or medical apparatus.

The need for some theoretical justification of the proposed algorithm arises from the necessity of verifying the solution from several points of view. This can be done through mathematical proofs of parts of the algorithm, and through tests of the final program with known examples. Such documentation and tests will be required by government agencies for medical use.

Problem B: Aluacha Balaclava College

Aluacha Balaclava College has just hired a new Provost. Problems with faculty compensation at the college forced the former Provost to resign, so the new Provost needs to make the institution of a fair and reasonable compensation system her first priority. As a first step in this process, she has hired your team as consultants to design a compensation system that reflects the following circumstances and principles.

Circumstances

There are four faculty ranks: Instructor, Assistant Professor, Associate Professor and Professor, in ascending order. Faculty with Ph.D. degrees are hired at the rank of Assistant Professor. Faculty who are working on a Ph.D. are hired at the rank of Instructor and promoted automatically to Assistant Professor upon completion of their degrees. Faculty may apply for promotion from Associate Professor to Professor after serving at the rank of Associate for seven or more years. The promotion decisions are made by the Provost with recommendations from a faculty committee and are not your concern.

Faculty salaries are for the ten-month period September through June. Raises are always effective beginning in September. The total amount of money available for raises varies from year to year and generally is not known until March for the following year.

The starting salary this year for an Instructor with no prior teaching experience was \$27,000 and for an Assistant Professor was \$32,000. Faculty can receive credit, upon hire, for as much as seven years of teaching experience at other institutions.

Principles

- All faculty should get a raise any year that money is available.
- Faculty should get a substantial benefit from promotion. If one is promoted in the minimum possible time, the benefit should be roughly equal to seven years of normal (non-promotion) raises.
- Faculty who get promoted on time (after seven or eight years in rank) and have careers of 25 or more years should make roughly twice as much at retirement as a new Ph.D. starting off.
- Faculty in the same rank with more experience should be paid more than others with less experience. But the effect of an additional year of experience should diminish over time. In other words, if two faculty stay in the same rank, their salaries should tend to get closer over time.

The Project

First, design a new pay system without cost-of-living increases. Then incorporate cost-of-living increases. The final piece of this project is to design a transition process for existing faculty that will move all salaries towards your system without cutting anyone's salary. The existing faculty salaries, ranks and years of service, are in **Table 1**. Discuss any refinements that you think would improve your system.

The Provost has asked for a detailed pay system plan that she can use for implementation, as well as a short executive summary in clear language, which she can present to the Board and to the faculty. The summary should outline the model, its assumptions, its strengths and weaknesses, and the expected results.

The Results

The solution papers were coded at COMAP headquarters so that names and affiliations of the authors would be unknown to the judges. Each paper was then read preliminarily by two "triage" judges at Salisbury State University, Maryland. At the triage stage, the summary and overall organization are the basis for judging a paper. If the judges' scores diverged for a paper, the judges conferred; if they still did not agree on a score, a third judge evaluated the paper.

Final judging took place at Harvey Mudd College, Claremont, California. The judges classified the papers as follows:

	Outstanding	Meritorious	Honorable Mention	Successful Participation	Total
Helix Intersection	3	18	43	82	146
College Salaries	<u>4</u>	<u>26</u>	<u>41</u>	<u>103</u>	<u>174</u>
	7	44	84	185	320

The judges designated seven papers as Outstanding. They appear in this special issue of *The UMAP Journal*. We list those teams and the Meritorious teams (and advisors) below; the list of all participating schools, advisors, and results is in the **Appendix**.

Table 1.
Salary data for Problem B.

Case	Years	Rank	Salary	Case	Years	Rank	Salary	Case	Years	Rank	Salary
1	4	ASSO	54,000	2	19	ASST	43,508	3	20	ASST	39,072
4	11	PROF	53,900	5	15	PROF	44,206	6	17	ASST	37,538
7	23	PROF	48,844	8	10	ASST	32,841	9	7	ASSO	49,981
10	20	ASSO	42,549	11	18	ASSO	42,649	12	19	PROF	60,087
13	15	ASSO	38,002	14	4	ASST	30,000	15	34	PROF	60,576
16	28	ASST	44,562	17	9	ASST	30,893	18	22	ASSO	46,351
19	21	ASSO	50,979	20	20	ASST	48,000	21	4	ASST	32,500
22	14	ASSO	38,462	23	23	PROF	53,500	24	21	ASSO	42,488
25	20	ASSO	43,892	26	5	ASST	35,330	27	19	ASSO	41,147
28	15	ASST	34,040	29	18	PROF	48,944	30	7	ASST	30,128
31	5	ASST	35,330	32	6	ASSO	35,942	33	8	PROF	57,295
34	10	ASST	36,991	35	23	PROF	60,576	36	20	ASSO	48,926
37	9	PROF	57,956	38	32	ASSO	52,214	39	15	ASST	39,259
40	22	ASSO	43,672	41	6	INST	45,500	42	5	ASSO	52,262
43	5	ASSO	57,170	44	16	ASST	36,958	45	23	ASST	37,538
46	9	PROF	58,974	47	8	PROF	49,971	48	23	PROF	62,742
49	39	ASSO	52,058	50	4	INST	26,500	51	5	ASST	33,130
52	46	PROF	59,749	53	4	ASSO	37,954	54	19	PROF	45,833
55	6	ASSO	35,270	56	6	ASSO	43,037	57	20	PROF	59,755
58	21	PROF	57,797	59	4	ASSO	53,500	60	6	ASST	32,319
61	17	ASST	35,668	62	20	PROF	59,333	63	4	ASST	30,500
64	16	ASSO	41,352	65	15	PROF	43,264	66	20	PROF	50,935
67	6	ASST	45,365	68	6	ASSO	35,941	69	6	ASST	49,134
70	4	ASST	29,500	71	4	ASST	30,186	72	7	ASST	32,400
73	12	ASSO	44,501	74	2	ASST	31,900	75	1	ASSO	62,500
76	1	ASST	34,500	77	16	ASSO	40,637	78	4	ASSO	35,500
79	21	PROF	50,521	80	12	ASST	35,158	81	4	INST	28,500
82	16	PROF	46,930	83	24	PROF	55,811	84	6	ASST	30,128
85	16	PROF	46,090	86	5	ASST	28,570	87	19	PROF	44,612
88	17	ASST	36,313	89	6	ASST	33,479	90	14	ASSO	38,624
91	5	ASST	32,210	92	9	ASSO	48,500	93	4	ASST	35,150
94	25	PROF	50,583	95	23	PROF	60,800	96	17	ASST	38,464
97	4	ASST	39,500	98	3	ASST	52,000	99	24	PROF	56,922
100	2	PROF	78,500	101	20	PROF	52,345	102	9	ASST	35,798
103	24	ASST	43,925	104	6	ASSO	35,270	105	14	PROF	49,472
106	19	ASSO	42,215	107	12	ASST	40,427	108	10	ASST	37,021
109	18	ASSO	44,166	110	21	ASSO	46,157	111	8	ASST	32,500
112	19	ASSO	40,785	113	10	ASSO	38,698	114	5	ASST	31,170
115	1	INST	26,161	116	22	PROF	47,974	117	10	ASSO	37,793
118	7	ASST	38,117	119	26	PROF	62,370	120	20	ASSO	51,991
121	1	ASST	31,500	122	8	ASSO	35,941	123	14	ASSO	39,294
124	23	ASSO	51,991	125	1	ASST	30,000	126	15	ASST	34,638
127	20	ASSO	56,836	128	6	INST	35,451	129	10	ASST	32,756
130	14	ASST	32,922	131	12	ASSO	36,451	132	1	ASST	30,000
133	17	PROF	48,134	134	6	ASST	40,436	135	2	ASSO	54,500
136	4	ASSO	55,000	137	5	ASST	32,210	138	21	ASSO	43,160
139	2	ASST	32,000	140	7	ASST	36,300	141	9	ASSO	38,624
142	21	PROF	49,687	143	22	PROF	49,972	144	7	ASSO	46,155
145	12	ASST	37,159	146	9	ASST	32,500	147	3	ASST	31,500
148	13	INST	31,276	149	6	ASST	33,378	150	19	PROF	45,780
151	4	PROF	70,500	152	27	PROF	59,327	153	9	ASSO	37,954
154	5	ASSO	36,612	155	2	ASST	29,500	156	3	PROF	66,500
157	17	ASST	36,378	158	5	ASSO	46,770	159	22	ASST	42,772
160	6	ASST	31,160	161	17	ASST	39,072	162	20	ASST	42,970
163	2	PROF	85,500	164	20	ASST	49,302	165	21	ASSO	43,054
166	21	PROF	49,948	167	5	PROF	50,810	168	19	ASSO	51,378
169	18	ASSO	41,267	170	18	ASST	42,176	171	23	PROF	51,571
172	12	PROF	46,500	173	6	ASST	35,798	174	7	ASST	42,256
175	23	ASSO	46,351	176	22	PROF	48,280	177	3	ASST	55,500
178	15	ASSO	39,265	179	4	ASST	29,500	180	21	ASSO	48,359
181	23	PROF	48,844	182	1	ASST	31,000	183	6	ASST	32,923
184	2	INST	27,700	185	16	PROF	40,748	186	24	ASSO	44,715
187	9	ASSO	37,389	188	28	PROF	51,064	189	19	INST	34,265
190	22	PROF	49,756	191	19	ASST	36,958	192	16	ASST	34,550
193	22	PROF	50,576	194	5	ASST	32,210	195	2	ASST	28,500
196	12	ASSO	41,178	197	22	PROF	53,836	198	19	ASSO	43,519
199	4	ASST	32,000	200	18	ASSO	40,089	201	23	PROF	52,403
202	21	PROF	59,234	203	22	PROF	51,898	204	26	ASSO	47,047

Outstanding Teams

Institution and Advisor

Team Members

Helix Intersections Papers

“A Specialized Root-Finding Method for Rapidly
Determining the Intersections of a Plane
and a Helix”

Harvey Mudd College
Claremont, CA
David L. Bosley

Matthew Evans
Andrew Flint
Noah Kubow

“The Single Helix”

Iowa State University
Ames, IA
Stephen J. Willson

R. Robert Hentzel
Scott Williams

“Planes and Helices”

Macalester College
St. Paul, MN
A. Wayne Roberts

Samar Lotia
Eric Musser
Simeon Simeonov

Faculty Salaries Papers

“Paying Professors What They’re Worth”

Harvey Mudd College
Claremont, CA
David L. Bosley

Jay Rosenberger
Andrew M. Ross
Dan Snyder

“The World’s Most Complicated Payroll”

North Carolina School of Science & Mathematics
Durham, NC
Dot Doyle

Frank Thorne
W. Garrett Mitchener
Marci Gambrell

“Long-Term and Transient Pay Scale for College
Faculty”

Southeast Missouri State University
Cape Girardeau, MO
Robert W. Sheets

Christena Byerley
Christina Phillips
Cliff Sodergren

“How to Keep Your Job as Provost”

University of Alaska Fairbanks
Fairbanks, AK
John P. Lambert

Liam Forbes
Marcus Martin
Michael Schmahl

Meritorious Teams

Helix Intersections Papers (13 teams)

Baylor University, Waco, TX (Frank H. Mathis)
 Beijing Institute of Tech., Beijing, China (Yan-ping Zhao)
 California Polytechnic State Univ., San Luis Obispo, CA (Thomas O'Neil) (two teams)
 Duke University, Durham, NC (David P. Kraines)
 Harvard University, Cambridge, MA (Harry R. Lewis)
 Lewis & Clark College, Portland, OR (Robert W. Owens)
 Natl. Univ. of Defense Tech., Changsha, Hunan, China (Wang XiaoXing)
 New Mexico Inst. of Mining and Tech., Socorro, NM (Brian T. Borchers)
 South China University of Tech., Guangzhou, Canton, China (Lejun Xie)
 Southeast University, Nanjing, Jiangsu, China (Huangjun Sunzhizhong)
 Trinity College Dublin, Dublin, Ireland (Timothy G. Murphy)
 University College Galway, Galway, Ireland (M. Tuite)
 University of Alaska Anchorage, Anchorage, AK (Ted L. Gifford)
 University of Utah, Salt Lake City, UT (Don H. Tucker)
 Worcester Polytechnic Institute, Worcester, MA (Arthur C. Heinricher)
 Xidian University, Xian, Shaanxi, China (Wang Yu Ping)
 Xidian University, Xian, Shaanxi, China (Ma Yu Xiang)

Faculty Salaries Papers (26 teams)

College of William & Mary, Williamsburg, VA (Hugo J. Woerdeman)
 Fudan University, Shanghai, China (Cao Yuan)
 Fudan University, Shanghai, China (Tan Yongji)
 Harbin Institute of Technology, Harbin, China (Shi Peilin)
 Hiram College, Hiram, OH (James R. Case)
 JiLin University, Changchun, Jilin, China (Lu Xian Yui)
 Kenyon College, Gambier, OH (Dana N. MacKenzie)
 Luther College, Decorah, IA (Reginald D. Laursen)
 Mt. St. Mary's College, Emmitsburg, MD (Fred J. Portier)
 Muhlenberg College, Allentown, PA (David A. Nelson)
 Natl. Univ. of Defense Tech., Changsha, Hunan, China (Wu MengDa)
 Shanghai Jiatong University, Shanghai, China (Longwan Xiang)
 Southwestern University, Georgetown, TX (Therese Shelton)
 Texas A & M Univ., College Station, TX (Denise E. Kirschner)
 Trinity College Dublin, Dublin, Ireland (James C. Sexton)
 U.S. Air Force Academy, USAF Academy, CO (Jeffrey S. Stonebraker)
 Univ. of Alaska Fairbanks, Fairbanks, AK (Patricia A. Andresen)
 Univ. of Colorado at Denver, Denver, CO (David C. Fisher)
 Univ. of Missouri–Rolla, Rolla, MO (Roger H. Hering)
 University of Dallas, Irving, TX (Charles A. Coppin)
 University of Dayton, Dayton, OH (Ralph C. Steinlage)
 Vilnius University, Vilnius, Lithuania (Ricardas Kudzma)
 Wake Forest University, Winston-Salem, NC (Stephen B. Robinson)
 Washington University, St. Louis, MO (Hiro Mukai)
 Wheaton College, Wheaton, IL (Paul Isihara)
 Xidian University, Xian, Shaanxi, China (Mao Yong Cai)

Awards and Contributions

Each participating MCM advisor and team member received a certificate signed by the Contest Director and the appropriate Head Judge.

The Institute for Operations Research and the Management Sciences (INFORMS) awarded to each member of two Outstanding teams a cash award and a three-year membership. The teams were from Macalester College (Helix Intersections Problem) and Harvey Mudd College (Faculty Salaries Problem). The teams made presentations at a special MCM session and were given cash awards. Moreover, INFORMS gave free one-year memberships to all members of Meritorious and Honorable Mention teams.

The Society for Industrial and Applied Mathematics (SIAM) designated one Outstanding team from each problem as a SIAM Winner. Each team member received a cash prize, and each team received a subsidized trip to the July 1995 SIAM Annual Meeting in San Diego, CA. The teams were from Iowa State University (Helix Intersections Problem) and from University of Alaska Fairbanks (Faculty Salaries Problem). These teams made presentations at a special modeling minisymposium.

Judging

Director

Frank R. Giordano, Dept. of Mathematical Sciences, U.S. Military Academy,
West Point, NY

Associate Directors

Chris Arney, Dept. of Mathematical Sciences, U.S. Military Academy,
West Point, NY

Robert L. Borrelli, Mathematics Dept., Harvey Mudd College,
Claremont, CA

Helix Intersections Problem

Head Judge

Marvin S. Keener, Mathematics Dept., Oklahoma State University,
Stillwater, OK

Associate Judges

Ben A. Fusaro (Triage), Dept. of Mathematical Sciences,
Salisbury State University, Salisbury, MD

Patrick Driscoll, Virginia Polytechnic Institute and State University,
Blacksburg, VA

Mario Juncosa, RAND Corporation, Santa Monica, CA

Veena Mendiratta, AT&T Bell Labs, Naperville, IL

Keith Miller, National Security Agency, Fort Meade, MD

Mike Moody, Harvey Mudd College, Claremont, CA

Lee Seitelman, Glastonbury, CT
Matthew Witten, University of Texas, Austin, TX
Daniel Zwillinger, Zwillinger & Associates, Arlington, MA

Faculty Salaries Problem

Head Judge

Maynard Thompson, Mathematics Dept., University of Indiana,
Bloomington, IN

Associate Judges

Robert M. Tardiff (Triage), Dept. of Mathematical Sciences,
Salisbury State University, Salisbury, MD

Karen Bolinger, Mathematics Dept., Arkansas State University,
State University, AR

James Case, Baltimore, Maryland

William Fox, Dept. of Mathematical Sciences, U.S. Military Academy,
West Point, NY

Jerry Griggs, University of South Carolina, Columbia, SC

Don Miller, Dept. of Mathematics, St. Mary's College, Notre Dame, IN

Peter Olsen, National Security Agency, Fort George G. Meade, MD

Judith Pastor, Haverly Systems, Inc., Houston, TX

Catherine Roberts, Mathematics Dept., University of Rhode Island,
Kingston, RI

Theresa Sandifer, Mathematics Dept., Southern Connecticut State Univ.,
New Haven, CT

Michael Tortorella, Middletown, NJ

Triage Session

Director

Ben A. Fusaro

Head Judge, Helix Intersections Problem

Ben A. Fusaro

Head Judge, Faculty Salaries Problem

Robert M. Tardiff

Associate Judges

Homer W. Austin

Alfred S. Beebe, University of Maryland, Eastern Shore, Princess Anne, MD

E. Boyd, University of Maryland, Eastern Shore, Princess Anne, MD

Donald C. Cathcart

S.M. Hetzler

T.O. Horseman

Peter Olsen, National Security Agency, Fort George G. Meade, MD

Fatollah Salimian

Kathleen M. Shannon

Barbara A. Wainwright

M.E. Williams

W.J. Yurek, Worcester-Wicomico Community College, Salisbury, MD

Except as noted, the triage judges were from Salisbury State University, Salisbury, MD.

Sources of the Problems

The Helix Intersections Problem was contributed by Yves Nievergelt (Eastern Washington University, Cheney, WA), who describes its origin in his Author's Commentary in this issue. The Faculty Salaries Problem was contributed by Kathleen M. Shannon (Salisbury State University, Salisbury, MD); the data are public information from Salisbury State University.

Acknowledgments

MCM was funded this year by the National Security Agency, whose support we deeply appreciate. We thank Dr. Gene Berg of NSA for his coordinating efforts. The MCM is also indebted to INFORMS and SIAM, which provided judges, prizes, and forums for presentations of student papers.

I thank the MCM judges and MCM Board members for their valuable and unflagging efforts. Harvey Mudd College, its Mathematics Dept. staff, and Prof. Borrelli were gracious hosts to the judges.

Cautions

To the reader of research journals:

Usually, a published paper has been presented to an audience, shown to colleagues, rewritten, checked by referees, revised, and edited by a journal editor. Each of the student papers here is the result of undergraduates working on a problem over a weekend; allowing substantial revision by the authors could give a false impression of accomplishment. So these papers are essentially *au naturel*. Light editing has taken place: minor errors have been corrected, wording has been altered for clarity or economy, and style has been adjusted to that of *The UMAP Journal*. Please peruse these student efforts in that context.

To the potential MCM Advisor:

It might be overpowering to encounter such output from a weekend of work by a small team of undergraduates, but these solution papers are highly atypical. A team that prepares and participates will have an enriching learning experience, independent of what any other team does.

Appendix: Successful Participants

KEY:

P = Successful Participation

H = Honorable Mention

M = Meritorious

O = Outstanding (published in this special issue)

A = Helix Intersections Problem

B = Faculty Salaries Problem

INSTITUTION	CITY	ADVISOR	A	B
ALABAMA				
Univ. of Alabama	Huntsville	Claudio H. Morales	P	
ALASKA				
University of Alaska	Anchorage	Ted L. Gifford	M	
	Fairbanks	John P. Lambert	H	O
		Patricia A. Andresen		
ARIZONA				
Northern Arizona U.	Flagstaff	Terence R. Blows	P	P
ARKANSAS				
Hendrix College	Conway	Ze'ev Barel		P
Williams Baptist Coll.	Walnut Ridge	Lana S. Rhoads		P
		Joy Holloway		P
CALIFORNIA				
Calif. Inst. of Tech.	Pasadena	Alexander S. Kechris	H	
Calif. Poly. State Univ.	S. Luis Obispo	Thomas O'Neil	M,M	
		Ernest Blattner		P
		James R. McKinney		P
Calif. State Poly. Univ.	Pomona	James R. McKinney		P
Calif. State University	Northridge	Gholam Ali Zakeri		P
Harvey Mudd College	Claremont	David L. Bosley	O	O
Humboldt State Univ.	Arcata	Jeffrey B. Haag	P	
		Kathleen M. Crowe	H	
		Thomas M. Zachariah	P	
Loyola Marymount U.	Los Angeles	Thomas M. Zachariah	P	
Pomona College	Claremont	Amy Radunskaya	H	
Sonoma State Univ.	Rohnert Park	Clement E. Falbo	H	
Univ. of California	Berkeley	Allen M. Chen	P	H
Univ. of Redlands	Redlands	Alexander E. Koonce		P
COLORADO				
Metro. State College	Denver	Thomas E. Kelley	P	
Regis University	Denver	Diane M. Wagner		P

INSTITUTION	CITY	ADVISOR	A	B
U.S. Air Force Acad.	USAF Acad.	Jeffrey S. Stonebraker	H,H	M
University of Colorado	Denver	David C. Fisher		M,P
U. of Northern Colorado	Greeley	William W. Bosch		P
U. of Southern Colorado	Pueblo	Paul R. Chacon		P
CONNECTICUT				
Southern Conn. St. Univ.	New Haven	Edward F. Aboufadel		P
University of Bridgeport	Bridgeport	Ninygi Wang		H
		Natalia B. Romalis	P	
University of Hartford	W. Hartford	Diego M. Benardete	P	
Western Conn. St. Univ.	Danbury	Edward Sandifer		H
		Judith A. Grandahl	H	
DISTRICT OF COLUMBIA				
Georgetown University	Washington	Andrew Vogt	P	P
FLORIDA				
Florida Inst. of Tech.	Melbourne	Laurene V. Fausett	P	
Jacksonville University	Jacksonville	Robert A. Hollister	P	
Stetson University	Deland	Lisa O. Coulter	P	
University of S. Florida	Fort Myers	Charles E. Lindsey		P,P
GEORGIA				
Wesleyan College	Macon	Joseph A. Iskra		P
IDAHO				
Lewis-Clark State Coll.	Lewiston	Brent Bradberry		P
ILLINOIS				
Illinois College	Jacksonville	Darrell E. Allgaier	H	
Illinois Wesleyan Univ.	Bloomington	Lawrence N. Stout	P	
Wheaton College	Wheaton	Paul Isihara		M
INDIANA				
Rose-Hulman Inst. of Tech.	Terre Haute	Aaron D. Klebanoff	P	
Saint Mary's College	Notre Dame	Peter D. Smith	P	P
Valparaiso University	Valparaiso	Rick Gillman	P	
IOWA				
Clarke College	Dubuque	Carol A. Spiegel		P,P
Grinnell College	Grinnell	Anita E. Solow		P,P
Iowa State University	Ames	Stephen J. Willson	O	
Luther College	Decorah	Reginald D. Laursen		M
Maharishi Int'l Univ.	Fairfield	Cathy Gorini	P	P
Teikyo Marycrest Univ.	Davenport	Susan T. Youngberg		P
Univ. of Northern Iowa	Cedar Falls	Timothy L. Hardy	P	
		Gregory M. Dotseth		H

INSTITUTION	CITY	ADVISOR	A	B
KANSAS				
Benedictine College	Atchison	Jo Ann Fellin, O.S.B.	P	
KENTUCKY				
Asbury College	Wilmore	Kenneth P. Rietz	H	H
Bellarmino College	Louisville	John A. Oppelt	H	
Western Kentucky U.	Bowling Green	Douglas D. Mooney		P
LOUISIANA				
McNeese State Univ.	Lake Charles	Sid L. Bradley	P	
		George F. Mead	P	
MAINE				
Bowdoin College	Brunswick	Adam B. Levy		P
Colby College	Waterville	Amy H. Boyd	P	
University of Maine	Orono	Grattan P. Murphy	P	
MARYLAND				
Hood College	Frederick	John Boon		P
Loyola College	Baltimore	Dipa Choudhury		H,H
Mt. St. Mary's Coll.	Emmitsburg	Fred J. Portier		M
		Theresa A. Francis	P	
Salisbury State U.	Salisbury	Kathleen M. Shannon		P
		Steve M. Hetzler	P	
Univ. of Maryland	College Park	Michael C. Fu		P
MASSACHUSETTS				
Harvard University	Cambridge	Harry R. Lewis	M,P	
		Roger W. Brockett	H	
Smith College	Northampton	Ruth Haas		P
U. of Massachusetts	Amherst	Edward A. Connors	H	H
Worcester Poly. Inst.	Worcester	Arthur C. Heinricher	M	
		Bogdan Vernescu	H	
MICHIGAN				
Calvin College	Grand Rapids	Steven P. Dirkse	P	
Eastern Michigan U.	Ypsilanti	Christopher E. Hee		H
Lawrence Tech. Univ.	Southfield	Ruth G. Favro	P	
		Howard Whitston	P	
Southwest. Mich. C.	Dowagiac	Ronald Sawatzky		P
MINNESOTA				
Macalester College	St. Paul	Wayne A. Roberts	O	H
Moorhead State Univ.	Moorhead	Ronald M. Jeppson		P
MISSISSIPPI				
Jackson State Univ.	Jackson	David C. Bramlett	H	
		Carl Drake		P

INSTITUTION	CITY	ADVISOR	A	B
MISSOURI				
Crowder College	Neosho	Cheryl Ingram		P
Missouri Southern St. Coll.	Joplin	Patrick Cassens		P,P
Northeast Missouri St. U.	Kirksville	Steven J. Smith		H
Northwest Missouri St. U.	Maryville	Russell N. Euler		P
Southeast Missouri St. U.	Cape Girardeau	Robert W. Sheets		O
University of Missouri	Rolla	Roger H. Hering		M
Washington University	St. Louis	Hiro Mukai	H	M
Wentworth Mil. Academy	Lexington	J.O. Maxwell		P
NEBRASKA				
Hastings College	Hastings	David B. Cooke		H
Nebraska Wesleyan Univ.	Lincoln	P. Gavin LaRose	P	
NEVADA				
Sierra Nevada College	Incline Village	Sue Welsch		P
NEW JERSEY				
New Jersey Inst. of Tech.	Newark	Bruce G. Bukiet		P
NEW MEXICO				
New Mexico State Univ.	Las Cruces	Marcus S. Cohen	H	
New Mexico Tech.	Socorro	Brian T. Borchers	M	
NEW YORK				
Hofstra University	Hempstead	R.N. Greenwell	P	P
Ithaca College	Ithaca	John C. Maceli		H
		James E. Conklin		H
Le Moyne College	Syracuse	William C. Rinaman		P
Nazareth C. of Rochester	Rochester	Ronald W. Jorgensen	H	
Pace University	Pleasantville	Robert A. Cicenia		P
Rensselaer Poly. Institute	Troy	Mark Levi	P	
Siena College	Loudonville	T.H. Rousseau	P	
Westchester Comm. Coll.	Valhalla	Rowan Lindley	P	
NORTH CAROLINA				
Appalachian State Univ.	Boone	Jaimie Hebert	P	
		Holly Hirst	H	
Duke University	Durham	David P. Kraines	M	
		Richard A. Scoville	H	
N.C. Schl. of Sci. & Math	Durham	Dot Doyle	H	O
Univ. of North Carolina	Wilmington	Russell L. Herman	H	
	Chapel Hill	Jon W. Tolle		H
Wake Forest University	Winston-Salem	Stephen B. Robinson		M
Western Carolina Univ.	Cullowhee	Jeff A. Graham		P
		Joseph S. Sportsman	H	

INSTITUTION	CITY	ADVISOR	A	B
NORTH DAKOTA				
Univ. of North Dakota	Williston	Wanda M. Meyer		P
	Grand Forks	David J. Uherka		P
OHIO				
College of Wooster	Wooster	Matthew Brahm		P
Hiram College	Hiram	Michael A. Grajek		P
		James R. Case		M
Kenyon College	Gambier	Dana N. MacKenzie	P	M
University of Dayton	Dayton	Ralph C. Steinlage		M
Xavier University	Cincinnati	Richard J. Pulskamp	H	
OKLAHOMA				
Oklahoma State Univ.	Stillwater	John E. Wolfe	H	
Southeastern Okla. St. U.	Durant	Brett M. Elliott		P
OREGON				
Lewis & Clark College	Portland	Robert W. Owens	M	
Southern Oregon St. C.	Ashland	Kemble R. Yates	P	
PENNSYLVANIA				
Bloomsburg University	Bloomsburg	Scott E. Inch	P	
Gannon University	Erie	Rafal F. Ablamowicz	P,P	
Gettysburg College	Gettysburg	James P. Fink		P
Messiah College	Grantham	D.C. Phillippy	H	
Muhlenberg College	Allentown	David A. Nelson		M,P
Univ. of Pittsburgh	Johnstown	Stephen J. Curran		P
Westminster College	N. Wilmington	Carolyn Cuff		P
RHODE ISLAND				
Rhode Island College	Providence	D.L. Abrahamson		P
SOUTH CAROLINA				
Central Carolina Tech. C.	Sumter	Karen G. McLaurin		P,P
The Citadel	Charleston	Kanat Durgun	P	
Coastal Carolina Univ.	Conway	Prashant S. Sansgiry	P	
Columbia College	Columbia	Scott A. Smith		P
Francis Marion Univ.	Florence	Catherine A. Abbott		P
Midlands Tech. College	Columbia	John R. Long	P	
		Rick Bailey		P
SOUTH DAKOTA				
Northern State Univ.	Aberdeen	A. S. Elkhader		H
TENNESSEE				
David Lipscomb Univ.	Nashville	Mark A. Miller	P	P

INSTITUTION	CITY	ADVISOR	A	B
TEXAS				
Baylor University	Waco	Frank H. Mathis	M	H
Southwestern University	Georgetown	Therese Shelton		M
Texas A & M University	Coll. Station	Denise E. Kirschner		M
University of Dallas	Irving	Charles A. Coppin		M
U. Texas–Pan American	Edinburg	Roger A. Knobel	P	P
UTAH				
University of Utah	Salt Lake City	Don H. Tucker	M,P	
Utah State University	Logan	Michael C. Minnotte		P
Weber State University	Ogden	Afshin Ghoreishi	P	
VERMONT				
Johnson State College	Johnson	Glenn D. Sproul		P,P
VIRGINIA				
Coll. of William & Mary	Williamsburg	Lawrence M. Leemis	P	
		Hugo J. Woerdeman		M
James Madison Univ.	Harrisonburg	James S. Sochacki	P	
Roanoke College	Salem	Jeffrey L. Spielman		P
Thomas Jefferson H. S. for Sci. & Tech.	Alexandria	Geraldine F. Oliveto	P	
		Peter J. Braxton	H	
University of Richmond	Richmond	Kathy W. Hoke	H	
Virginia Pol. Inst. & St. U.	Blacksburg	Joel A. Nachlas		H
		Sheldon H. Jacobson	P	
WASHINGTON				
Eastern Wash. Univ.	Cheney	David Jabon	P	
Univ. of Puget Sound	Tacoma	Robert A. Beezer		P
		Martin Jackson		H
Western Wash. Univ.	Bellingham	Tjalling J. Ypma	H	P
WISCONSIN				
Alverno College	Milwaukee	Susan F. Pustejovsky		P,P
Beloit College	Beloit	Philip D. Straffin	P	P
Northcentral Tech. Coll.	Wausau	Frank J. Fernandes	P	
		Robert J. Henning	P	
		Carmen Olson		P
Ripon College	Ripon	Robert J. Fraga		H,P
St. Norbert College	De Pere	John A. Frohlinger		P
University of Wisconsin	Madison	Howard E. Conner	H	
	Oshkosh	Andrew E. Long	P	
		K. L. D. Gunawardena		P

INSTITUTION	CITY	ADVISOR	A	B
University of Wisconsin	Platteville	Sherrie Nicol		H
		Clement T. Jeske		H
	Stevens Point	Norman Curet		H
BULGARIA				
Bulgarian Acad. of Sci.	Sofia	Jordan B. Tabov	P	
		Petar S. Kenderov		H
CANADA				
Scarborough College, University of Toronto	Toronto, Ont.	Paul S. Selick	P,P	
		University of Calgary	David R. Westbrook	P
		University of Toronto	Luis A. Seco	H,H
CHINA				
Anhui University	Hefei	Teng Yaoqing	P	
		Wang Huimin	P	
Automation Eng'ng Coll. of Beijing Union Univ.	Beijing	Ren Kai-long		P
		Wang Xin-feng	H	
Beijing Institute of Tech.	Beijing	Zhao Yan-ping	M	
		Qin Hongxun	H	
Beijing Normal University	Beijing	Liu Laifu	H	
		Zeng Wenyi		P
		Di Zhengru		P
Beijing U. of Post & Tel.	Beijing	Ding Jinkou	P	
		Luo Shou Shan	P	
Beijing U. of Sci. & Tech.	Beijing	Wang Bingtuan		P
		Chen Mingwen		P
		Yang Xiaoming	P	P
China Pharmaceutical U.	Nanjing	Yang Jing Hua	P	
		Qiu Jia Xue		H
Chongqing University	Chongqing	Chu Gong		H
		Ren Shanqiang		H
		Qu Gong	P	
		Liu Qiongxun		P
Dalian University of Tech.	Dalian	Yu Hong Quan		H
		He Ming Feng	P	
E. China U. of Sci. & Tech.	Shanghai	Xu Sanbao		H,H
		Yuanhong Lu	P,P	
Fudan University	Shanghai	Cao Yuan		M
		Tan Yongji		M
		Ye Yao-hua		H
		He Ye		P

INSTITUTION	CITY	ADVISOR	A	B
Harbin Engineering Univ.	Harbin	Zhang Xiaowei		P
		Shen Jihong		H
		Gao Zhenbin		P
Harbin Institute of Tech.	Harbin	Shi Peilin	P	M,P,P
Hefei University of Tech.	Hefei	Du Xueqiao		H
Huazhong U. Sci. & Tech.	Wuhan	Qi Huan		P
JiLin University	Changchun	Lin Zhenghua	H	
		Lu Xian Yui		M
		Zhao Shuven		P
Jinan University	Guangzhou	Zeng Yijun		P
		Fan Suohai		P
Nanjing U. Aero. & Astro.	Nanjing	Zhang Yi	H	
		Gu Yudi		H
		Zhou Yiqian		H
Nanjing U. of Sci. & Tech.	Nanjing	Qian Xiong Ping		P
		Zhao Chong Gao	P	
Natl. U. of Defense Tech.	Changsha	Wu MengDa		M
		Wang XiaoXing	M	
		Wu Yi	H	
Northwestern Poly. Univ.	Xian	Su Chaowei	P	
		Xu Wei	P	
		Yang Jian	P	
		Rong Haiwu	P	
Peking University	Beijing	Lei Gongyan	H	
		Wu Wei Min		P,P
Shanghai Jiatong Univ.	Shanghai	Xiang Longwan	H	M
		Chen Zhihe	H	H
Shanghai Teachers' Univ.	Shanghai	Dan Sha		H
South China U. of Tech.	Guangzhou	Xiao Renyue		H
		Xie Lejun	M	
		Zhu Fengfeng		P
Southeast University	Nanjing	Deng Jian-ming		H
		Huangjun Sunzhizhong	M	
Tsinghua University	Beijing	Gao Celi		P
		Song Binheng		P
U. of Sci. & Tech. of China	Hefei	Wang Shuhe	H	
		Xu Junming		H
Xian Jiaotong University	Xian	He Xiaoliang		P
		Dong Tianxin	P	
		Zhou Yicang	P	
		Dai Yonghong	P	

INSTITUTION	CITY	ADVISOR	A	B
Xidian University	Xian	Cai Mao Yong		M
		Wang Yu Ping	M	
		Ma Yu Xiang	M	
Zhongshan University	Guangzhou	Zhang Lei	P	P
		He Yuanjiang		P
HONG KONG				
Hong Kong Baptist University	Kowloon	Wai Chee Shiu		P
		Li Zhi Liao		H
IRELAND				
Trinity College Dublin	Dublin	James C. Sexton		M
		Timothy G. Murphy	M	
University College Galway	Galway	Patrick M. O'Leary	H	
		M. Tuite	M	
LATVIA				
University of Latvia	Riga	Janis P. Vucans	P,P	
LITHUANIA				
Vilnius University	Vilnius	Algirdas Zabulionis	P	
		Ricardas Kudzma		M
ZIMBABWE				
University of Zimbabwe	Harare	James Preen		P

