



# Evaluation Data Report

## Investigative Workshop: *Mathematical Modeling of Intracellular Movements*

October 24-26, 2011

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November, 2011

# Table of Contents

Background.....	1
Introduction .....	1
Workshop Description .....	1
Evaluation Design .....	3
Evaluation Questions.....	3
Evaluation Procedures .....	3
Evaluation Findings.....	4
Overall Satisfaction.....	4
Workshop Content and Format.....	5
Participant Learning .....	5
Workshop Format .....	7
Most Useful Aspects of Workshop .....	7
Communication.....	9
Progress Toward Goals .....	10
Impact on Future Research Plans.....	11
Impact on Future Collaborations .....	12
Suggestions for Future workshops .....	13
Additional Comments .....	14
Appendix.....	16

## Table of figures

Figure 1. Satisfaction with various aspects of the workshop.....	4
Figure 2. Participant learning .....	5
Figure 3. Do you feel that participating in the workshop helped you better understand the research going on in disciplines other than your own regarding modeling renal hemodynamics?6	
Figure 4. Effectiveness of workshop format.....	7
Figure 5. How satisfied were you with the opportunities provided during workshop presentations and discussions to ask questions and/or make comments? .....	9
Figure 6. Do you feel the workshop made adequate progress toward finding a common language across disciplines for research on the workshop's topic? .....	10
Figure 7. Do you feel that the exchange of ideas that took place during the workshop will influence your future research? .....	11
Figure 8. Did you develop plans for collaborative research with other workshop participants? ..	12

# *Mathematical Modeling of Intracellular Movements*

## *Workshop*

### Evaluation Data Report

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## Background

### Introduction

This report contains evaluation data for a NIMBioS Investigative Workshop entitled “*Mathematical Modeling of Intracellular Movements*” (MMIMO workshop), which took place at NIMBioS October 24-26, 2011. NIMBioS Investigative Workshops are relatively large (30-40 participants), focus on a broader topic or a set of related topics than Working Groups, attempt to summarize/synthesize the state of the art and identify future directions, and have potential for leading to one or more future Working Groups. Participants may include post-docs and graduate students with less experience in the particular topic than those participating in Working Groups.

The MMIMO workshop comprised 38 participants, including co-organizers Vasileios Maroulas (Dept. of Mathematics, Univ. of Tennessee), Andreas Nebenführ (Dept. of Biochemistry and Cellular and Molecular Biology, Univ. of Tennessee), Ram Dixit (Dept. of Biology, Washington Univ.), Panos Stinis (Dept. of Mathematics, Univ. of Minnesota), and Anja Geitmann (Dept. of Biological Sciences, Univ. of Montreal).

### Workshop Description

Recent advances in live cell microscopy have resulted in a flood of time-lapse observations that reveal a high degree of motility inside cells. Quantitative analysis of these movements is necessary to gain a full understanding of intracellular dynamics and their regulation. This analysis is often hampered by the sheer complexity of the movements, the great number of objects to be tracked, and the diffraction limit of optical microscopes. At the same time, mathematical and statistical models have made significant progress in producing fast algorithms that reliably track multiple objects in space. In some cases, these models were successfully applied to cell biological data sets, but the full potential of a rigorous mathematical approach that can be employed across a wide range of biological processes has not been realized. MMiMo brought together experts from cell biology as well as mathematics, statistics, computational science and physics to discuss current approaches and possible alternatives.

MMiMo’s first goal was to address to an interdisciplinary audience for the first time the major challenges for developing robust computational algorithms to reliably track intracellular dynamics. Some of the key challenges included:

- describing the dynamics of the motion of intracellular objects,
- estimating the parameters of the dynamics, e.g. the noise magnitude,
- improving existing tracking algorithms, and

- developing algorithms to associate each object to a specific observation.

Overcoming of the mathematical and computational problems will lead to the MMiMo's second aim to answer biological questions, such as:

- Which quantitative differences exist between organelle movements that rely on different cytoskeletal tracks or that employ different molecular motors?
- Can comprehensive analysis of all movements reveal a global regulation of intracellular dynamics?
- Do different organelles respond to different regulatory signals?
- How do rapid intracellular movements contribute to cell polarity?

Workshop organizers anticipated that the creation of a set of robust computational algorithms will enable cell biologists to address additional questions in a quantitative fashion.

# Evaluation Design

## Evaluation Questions

The evaluation of the workshop was both formative and summative in nature, in that the data collected from respondents was intended to both gain feedback from respondents about the quality of the current workshop and also to inform future similar meetings. Several questions constituted the foundation for the evaluation:

1. Were participants satisfied with the workshop overall?
2. Did the meeting meet participant expectations?
3. Do participants feel the workshop made adequate progress toward its stated goals?
4. Do participants feel they gained knowledge about the main issues related to the research problem?
5. Do participants feel they gained a better understanding of the research across disciplines related to the workshop's research problem?
6. What impact do participants feel the workshop will have on their future research?
7. What changes in accommodations, group format, and/or content would participants like to see at future similar meetings?

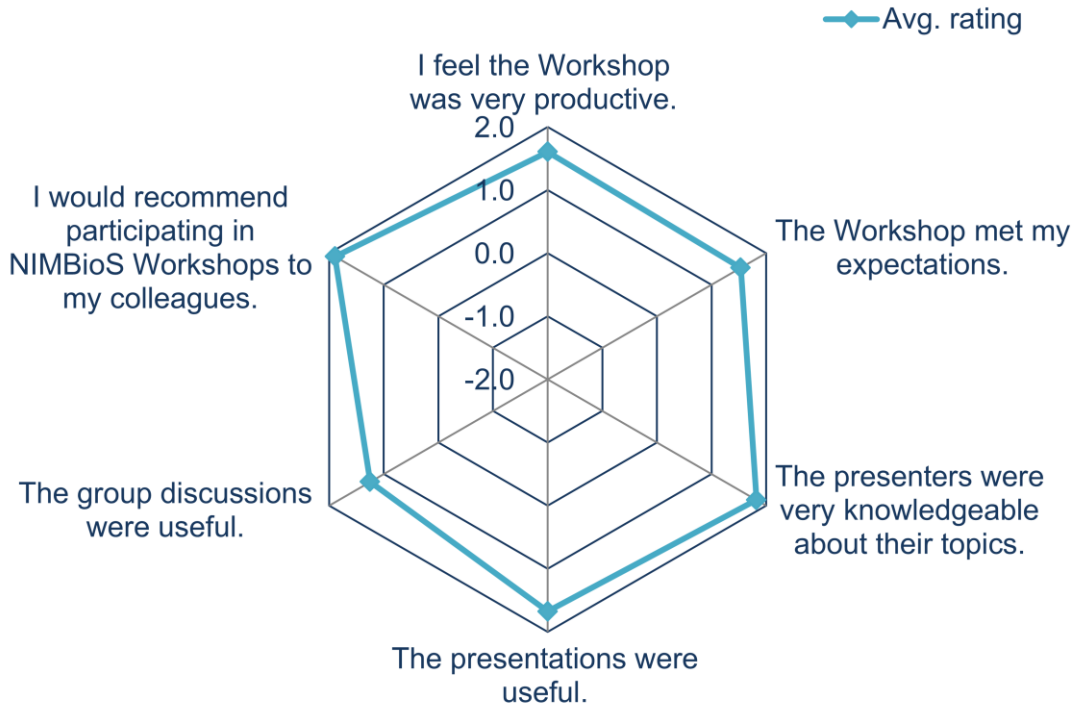
## Evaluation Procedures

An electronic survey aligned to the evaluation questions was designed by the NIMBioS Evaluation Coordinator with input from the NIMBioS Director and Deputy Director. The final instrument was hosted online via the University of Tennessee's online survey host mrlInterview. Links to the survey were sent to the 38 registered workshop participants on October 26, 2011. Reminder emails were sent to non-responding participants on November 2 and 9, 2011. By November 15, 2011, 36 of the participants had given their feedback, for a response rate of 95%.

# Evaluation Findings

## Overall Satisfaction

Figure 1. Satisfaction with various aspects of the workshop



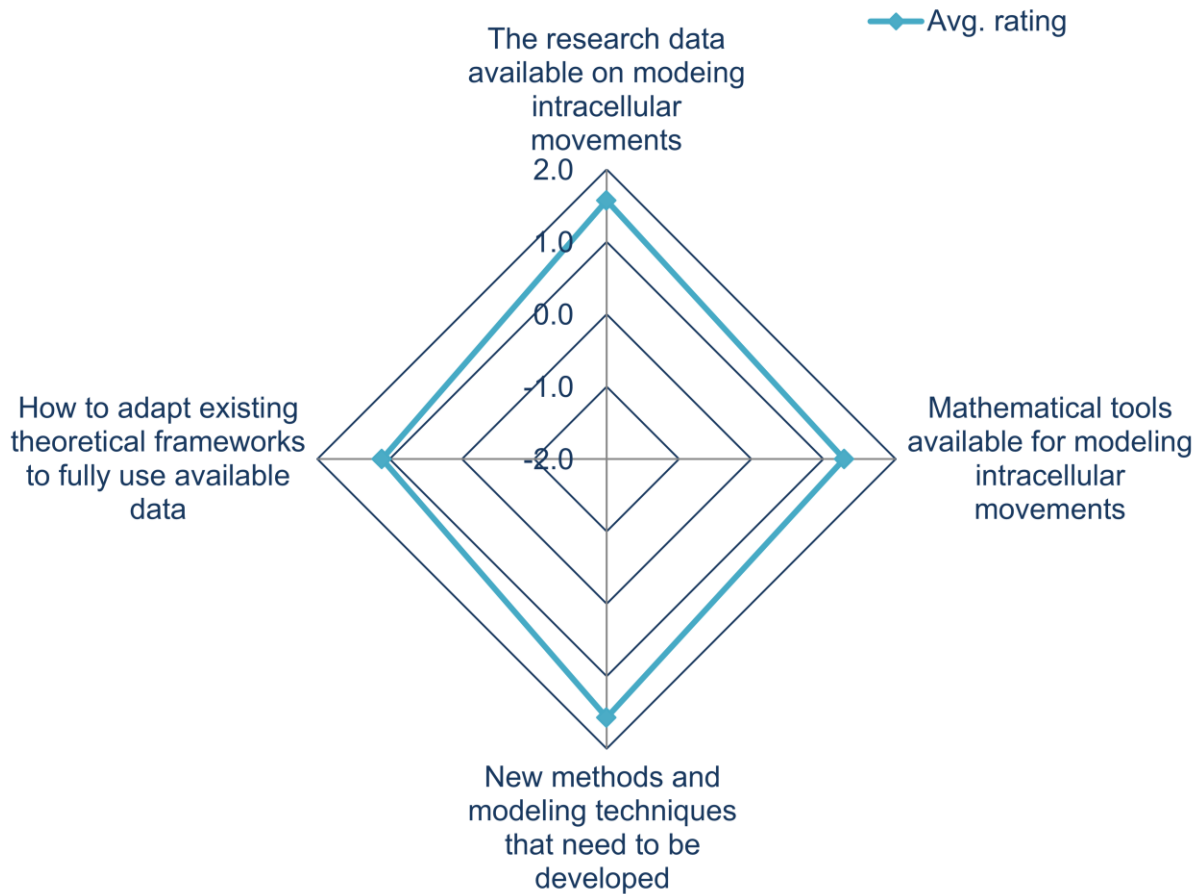
Scored on a 5-point Likert scale from -2 to 2 for “strongly disagree” to “strongly agree”

## Workshop Content and Format

### Participant Learning

Figure 2. Participant learning

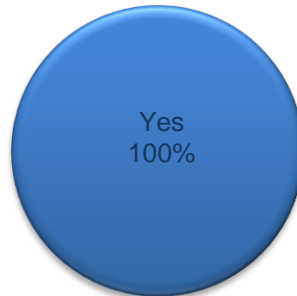
*As a result of attending this workshop, I have a better understanding of:*



Scored on a 5-point Likert scale from -2 to 2 for “strongly disagree” to “strongly agree”



**Figure 3. Do you feel that participating in the workshop helped you better understand the research going on in disciplines other than your own regarding modeling renal hemodynamics?**



### **Comments**

*Being a cell biologist, my math is relatively weak. I think I better understand some of the math concepts applied to my problem, but I'm not sure I would get the math research behind the math application.*

*I feel that the mathematicians could have tried to break down the info and make it more understandable to the biologist but I always had a sense of the general picture. I realize this is a difficult task.*

*I realized that the kind of problems I study and the method I use or develop are very similar to what is studied or needed by the plant community*

*It was really nice to attend the workshop. I came from long distance to participate the workshop, and thank God I am really satisfied with the organizers of the workshop, the presenters, and the skill they have, the group discussion. As a suggestion it is good also to give opportunity for the people from other continents like Africa so that you can get more experience on how things are going on around there. As a final comment, please keep it up and have similar workshops to the young generations in order to get young researchers and scientists.*

*The workshop was highly informative and gave me a better perspective on what the current limitations and challenges are for modeling of intracellular movement.*

*Very helpful!*

*Very helpful.*

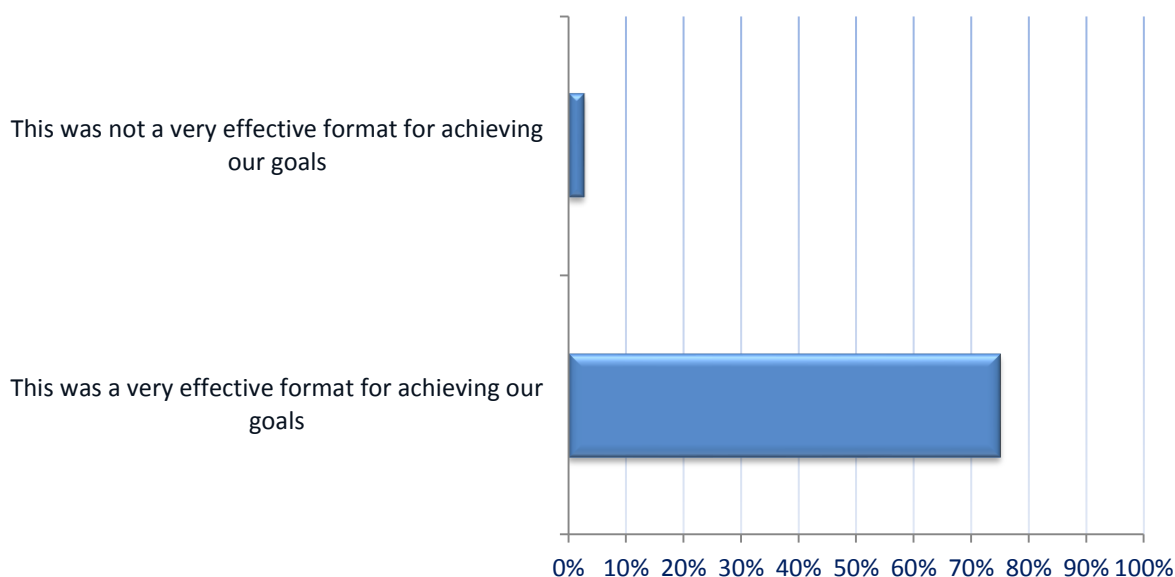
*Yes I realized that the programing problems can be broken down into two categories: data analysis and modeling. I think that the conference was an excellent idea.*

*Yes, I learn a lot of biology in the workshop and am excited about many of the biological problems raised in the workshop.*

*Yes, it gave me a much better idea of the mathematical and physics side of research in intercellular movements. I think getting the diverse opinions and expertise has given me fresh ideas for my own experiments.*

## **Workshop Format**

**Figure 4. Effectiveness of workshop format**



### **Format could be improved if:**

*No comments*

### **Most Useful Aspects of Workshop**

*Bringing mathematicians, biologists, engineers and physicists together in an open discussion environment. Many of the discussions after the talks were extremely useful.*

*Bringing together a small group of experts allowing easy exchange of ideas / methods through discussion.*

*Development of a common language among the attendees Making contacts with modelers*

*Good talks, good discussions and good networking opportunities.*

*Having Biologist, Physicist, and Mathematicians working on problems together*

*I think the success may be due to the fact that is highly focused, and there are enough outside people who're not usually in the loop so that there are many new ideas to be bounced around among different disciplines. For example, most biologists in the workshop are very knowledgeable in their own field, but have the vision of appreciating quantitative techniques; vice versa, mathematicians and statisticians are not equally impressed by the complexity and beauty of biological processes and measurements, and are willing to collaborate with subject specialists to develop appropriate models and techniques to address the real important issues that are of interest to biologists.*

*Interacting with a group of people with a common set of problems.*

*Interactions with mathematicians, and cell biologists with more quantitative approaches to study organelle movement.*

*It brings people with the same interest while from different disciplines together, provides us opportunities to talk and listen to each other.*

*It provides us the opportunity to meet with people from different disciplinary but has the same interests.*

*Knowing how biology works and what are biologists looking for in the research.*

*Learning about the mathematical side of cell trafficking modeling, and learning about new techniques I can use in my research.*

*Meeting the other players in the field.*

*Networking and learning about outreach activities.*

*People from different area discussed together.*

*Small group Time for discussion my discussion group was very dynamic and interesting*

*The group discussion, the combination of the participants from different fields.*

*The group discussions were extremely useful. Having the open dialog in smaller groups, and bouncing ideas off of each other was incredibly useful.*

*The interaction among mathematicians and biologists*

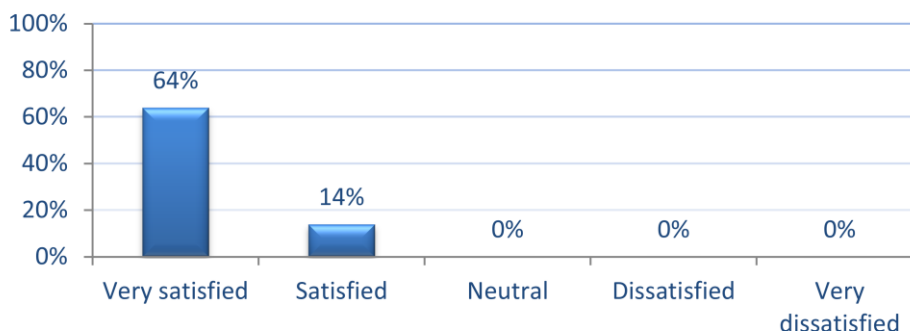
*The mathematical talks that described image analysis methods.*

*The talks and discussions*

*Understand the biology and data collections. The difficulties and possible solutions.*

## Communication

**Figure 5. How satisfied were you with the opportunities provided during workshop presentations and discussions to ask questions and/or make comments?**



## Comments

*Could allocate more discussion times after each talk.*

*I think that it would have been nice to have one of the meeting coordinators in our discussion session to help know what was expected in the discussion group.*

*I wonder if we can have a listserv of graduate students and postdocs who attended, so that we can keep in touch.*

*More communication channels after the workshop may be useful such as some teleconferences to report any progress or separate group discussions.*

*More discussion times after each talk.*

*Perhaps a panel discussion after each session (morning, afternoon) with that session's speakers and the audience. This can also be done at the end of the day.*

*Personally I don't have good communication skill, may be the culture that I have grown up was influencing me. but I really appreciate some of the workshop organizers like Ram Daxit, Anija Geitmann and other staffs and participants like, Natasha worden, Nolan Ung, Peter Hinow and others who are coming and meeting me and giving me the opportunity to describe myself to them.*

*Questions to the speakers during or after their talks should always be short and direct.*

*The online Wiggio Group should be a great platform for communication, but seems not be emphasized and fully used.*

## Progress Toward Goals

Figure 6. Do you feel the workshop made adequate progress toward finding a common language across disciplines for research on the workshop's topic?



### Comments

*Definitely bringing the group together was informative. I don't know if a common language was achieved.*

*I feel it made progress but I believe there is still a gap and a lot of progress needs to be made.*

*I think so, and i hope organizers can capitalize on the momentum and excitement generated from the workshop and NIMBioS can facilitate collaborations on at least several topics that are found important in the workshop, such as best practice for microscopic imaging and live cell imaging tracking, measurement issues with nonstandard geometric objects, and mathematical modeling issues with intracellular dynamics.*

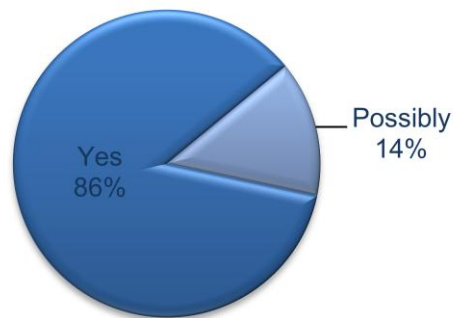
*It was a very good start, I think this should be done more often, though, and maybe lead towards some common database of knowledge from both sides and combined journals.*

*Sure, I have seen people from mathematical back ground understanding and communicating easily with the biological departments. me too, I was from department of computer science and bioinformatics, but I tried to understand them and the biological words was a little bit difficult for me, but the way how they express lets me to understand easily.*

*Yes, after several days I began to better appreciate how to effectively communicate the questions we are interested to those who were non biologists.*

## Impact on Future Research Plans

Figure 7. Do you feel that the exchange of ideas that took place during the workshop will influence your future research?



### Comments

*Absolutely, The workshop gave me many new ideas and leads for our project on the modeling of intracellular movement of clathrin coated vesicles*

*As described above, we initiated a collaboration, which if successful, will allow us to do mathematical modeling of organelle movement for the first time.*

*I talked to some professors with relative research aspects and learned a lot new tools and methods to deal with my current problems. They also made good suggestion for my projects.*

*I think so, but I'm not sure, at least it gives me an opportunity to think about it. but it's hard to talk about it right now.*

*I will test more existing programs on my system. This work shop has also shown me how much the community values ImageJ. If I develop an algorithm I will implement it in ImageJ. I have also realized the importance of a dynamic model and plan to collaborate with a lab at my university to develop one.*

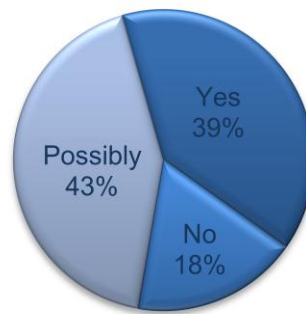
*It made me more aware of the processes involved in intracellular movements, which I'll have in mind when trying to develop appropriate mathematical models.*

*The discussions we had gave me a better vision of the open directions, and enabled potential future collaborations.*

*Using the right model should help focus my research, while giving it more depth.*

*Yes, I think I'm convinced now that biology is ready for quantitative analysis using mathematical and statistical techniques and I would like to focus more on mathematical biology in my future research.*

**Figure 8. Did you develop plans for collaborative research with other workshop participants?**



## ***Impact on Future Collaborations***

### ***Comments***

*I found several methods that could be potentially useful for my research. I am hoping that the contacts developed during the workshop will result in future collaborations, but nothing concrete as yet.*

*I have images that I will send to a collaborator who will test his detection algorithm on them. likewise I will test my detection algorithm on his images as well.*

*I initiated collaboration with an Engineer in applied mathematics and statistics on tracking of organelle movement, which was great.*

*I made connections with people I may contact later on in my research for collaboration.*

*I try to communicate and talk with the group participants if there are opportunities we can collaborate and everybody was willing. Hopefully i will be in touch with some of them soon.*

*I would like to follow up with at least two groups who have found my quantitative shape analysis method useful to their data (UC Riverside, Worcester Polytechnic Institute). Also I found the problem of measurement of movement with nonstandard geometric object to be of most interest and would like to follow up on the literature and some potential collaborators on this topic.*

*I'm going to contact a few participants to find out if we can work on a specific problem jointly.*

*It provided an excellent forum to make contacts and to setup collaborations with people interested in modeling that might not have happened otherwise*

*Need to dig more depth into a specific problem and then propose a doable collaboration.*

*One of the modelers has generated a model of which I was not aware that explicitly addresses my research question. He seemed quite happy to share his algorithms and other results.*

*With Prof. Vasileios Maroulas, we plan to collaborate on developing better algorithms for tracking.*

## **Suggestions for Future workshops**

*better structure for the discussion groups, especially for modeling. Since there are many distinct approaches on different biological problems, it was difficult to find a common point to discuss. For discussions on single molecule techniques and experimental approaches, this was not the case.*

*I think that both the biological and mathematical talks could be made more understandable to the other side. Many of the mathematical slides were completely unintelligible to me because I did not understand the terms. This may take too much time and take away from the necessary detail.*

*I would like the future workshop to add a format like posters or very short talks (like 5 minutes) so anyone in attendance can present what they're interested or working on if interested.*

*I would not make any significant changes.*

*I'd invite more well-known researchers to give presentations. I'd leave more times for discussions after each presentation. I'd suggest some more specific topics (could be topics presented by speakers that day) for study groups.*

*Insist on all the speakers giving the same talk format, and not just bombarding the audience with data. Need clear questions that are understood by experts in all disciplines.*

*Maybe adding other researchers and increase the number of participants.*

*more salad at lunch :-)*

*Not much.*



*Provide some information prior to arrival to orient people to the types of problems to be discussed.*

*The discussion session could be more specific, i.e. focusing on a more specific problem.*

*The first day could've started a little later. After traveling from the west coast and getting in at 10:00 P.M eastern, I found the first block of talks hard to get through because of jetlag.*

*The food - it was mediocre at best. The dinner at the restaurant was just painful - service was sloooooooooow and for a full-service restaurant, putting out a fixed menu didn't make any sense. I am vegetarian and my option was to eat the one veggie dish (why go to a restaurant if someone has already decided what I am eating?). And no dessert?*

*The food was awful and I thought the organizing (in terms of travel) could have been done better. Why did we all have to stay overnight on Wednesday when most of us could have flown out on that day.*

*The topics of the discussion groups could be more specific, or include some specific problems at least. Or the discussion might be too general and inefficient. Groups can start with some general discussions, and then focus on some specific problems.*

*There should have been advance information about the fact that there wasn't a group leader for each of the discussion groups. Maybe one of the organizers could have taken on that role, alternatively information should have been sent out in advance, so that we could have prepared more for our group discussions. Also, the conference program could perhaps have been sent out earlier, i.e. start and end times for conference.*

*To improve this workshop I would suggest to also invite electrical engineers that can discuss computer vision and image analysis and processing.*

*Tutorials on the math for the non-math people.*

*Would invite some better experts in the area to give talks.*

## **Additional Comments**

*Collaborations with other participants will likely develop in the near future.*

*Excellent organization, wonderful facility, perfect setting. Thanks for having us!*

*Good job on organizing the workshop. Keep on the progresses. Thanks!*

*Great meeting! The number of attendees and the variety of their backgrounds was perfect. I really appreciated the free time between the sessions and during lunch and dinner that encouraged interactions with the other participants*

*I am very pleased with the workshop. The organizers did a wonderful job.*

*I thought the conference was a good one. Thanks*

*I thought the workshop was both informative and fun and I especially enjoyed how multidisciplinary the seminar and discussions were. I think the discussions could have been a little more structured to stay on topic, but other than that very enjoyable workshop.*

*I want to thank NIMBioS for the opportunity to host this workshop! It was extremely productive in my view. People had a great time discussing ideas and thinking about new ways to solve common problems. Without these kinds of workshops, such interactions would not have taken place!*

*I would like to be informed of NIMBioS workshops in the future. I am amazed by the range of work conducted here and I would love to contribute.*

*I would like to thank you for NIMBioS for giving me the opportunity to attend the workshop. And thanks all so for the workshop organizers for preparing such a very nice workshop and for the presenters who shares me their knowledge and experience during the workshop. Hopefully we will meet in a similar workshop, and I will share all the experiences and knowledge to my Colleagues that I've got from the workshop.*

*The NIMBioS workshop was a fantastic forum to bring mathematicians and biologists together and help them understand the interests, requirements, and limitations of the other. Finding a common language is a major challenge and this workshop gave us an opportunity to move forward along this path.*

*Very well organized and useful workshop!! Thanks*

# Appendix

Mathematical Modeling of Intracellular Movements Workshop Evaluation Survey

## Mathematical Modeling of Intracellular Movements Workshop Survey

Thank you for taking a moment to complete this survey. Your responses will be used to improve the workshops hosted by the National Institute for Mathematical and Biological Synthesis. Information supplied on the survey will be confidential, and results will be reported only in the aggregate.

Please check the appropriate box to indicate your level of agreement with the following statements about this workshop: (Very satisfied, Satisfied, Neutral, Dissatisfied, Very dissatisfied)

- I feel the workshop was very productive.
- The workshop met my expectations.
- The presenters were very knowledgeable about their topics.
- The presentations were useful.
- The group discussions were useful
- I would recommend participating in NIMBioS workshops to my colleagues.

Please check the appropriate box to indicate your level of agreement with the following statements. As a result of participating in this workshop, I have a better understanding of: (Strongly agree, Agree, Neutral, Disagree, Strongly disagree)

- The research data available on the workshop's topic
- Mathematical tools available for modeling intracellular movements
- New methods and modeling techniques that needs to be developed
- How to adapt existing theoretical frameworks to fully use available data

Do you feel participating in the workshop helped you better understand the research going on in disciplines other than your own?

- Yes
- No
- Comments:

Do you feel the workshop made adequate progress toward finding a common language across disciplines for research on the workshop's topic?

- Yes
- No
- Comments:

Do you feel that the exchange of ideas that took place during the workshop will influence your future research?

- Yes
- No
- Possibly
- Comments:

Did you develop unanticipated plans for collaborative research with other workshop participants?

- Yes
- No
- Possibly
- Comments:

What do you feel was the most useful aspect of the workshop?

What would you have changed about the workshop?

How do you feel about the format of the workshop?

- This was a very effective format for achieving our goals
- This was not a very effective format for achieving our goals ->
- The workshop format would have been more effective if:

How satisfied were you with the opportunities provided during workshop presentations and discussions to ask questions and/or make comments?

- Very satisfied
- Satisfied
- Neutral
- Dissatisfied
- Very Dissatisfied

Please indicate any suggestions you have for facilitating communication among participants during the workshop:

Please use this space for additional comments: