INTERNATIONAL CONFERENCE EXPLORING RESEARCH AND PROGRAMMING POTENTIAL FOR LABANOTATION

April 24-26, 2004, 29 leaders in dance research, notation and technology spent two days together discussing what they wanted Labanotation (LN) software to be able to do, and how today's technology could be used to meet these goals. A list of participants is appended. Their goal was to define what an "intelligent" notation program might contain and be able to do. The Dance Notation Bureau Extension for Education and Research at Ohio State University, and the Dance Notation Bureau, New York jointly sponsored the meeting, funded by the Battelle Endowment for Technology and Human Affairs at The Ohio State University. It was hosted by the Department of Dance and the DNB Extension at OSU and co-organized by Ilene Fox of the DNB, and Sheila Marion and Lucy Venable of the DNB Extension at OSU.

The Conference
Saturday April 24, 2004 and Sunday April 25, 2004

Introductions and goals: The conference began with welcoming statements by the conference organizers and introductions all around. Ilene Fox defined an intelligent software program as one whose symbols carry meaning and is analogous to a language, with syntax and grammar.

She also stated the goals for the conference and what we wanted to accomplish over the two days:

- Identify dance research needs supported by notation;
- Identify educational needs that could be supported by an intelligent notation program;
- Identify how these needs could be supported by technology: which of these needs might an intelligent program be able to meet, what potential new applications might we want to develop?
- Identify what an intelligent program would need to contain/generate. How it would need to be designed to allow for development we want to happen;
- Identify long-range goals for developing an intelligent notation program and new applications for dance research**.**

Demonstrations: An overview and discussion of existing projects using Laban-based software followed, ranging from software created to produce graphic symbols for writing scores (Calaban, LabanWriter, Labanatory) to projects using Labanotation and Laban

Movement Analysis for teaching and research (LabanReader, Labanatory, LabanDancer and Laban Capture.)

- Andy Adamson (Honorary Senior Research Fellow, University of Birmingham, Birmingham, England) demonstrated **Calaban**. Calaban utilizes the commercial program AutoCAD and a library of symbols developed by Adamson to produce Labanotation scores.

- David Ralley (programmer of LabanWriter 4.0, Petaluma, CA) demonstrated **LabanWriter**, a program developed at The Ohio State University for producing Labanotation scores. Lucy Venable and George Karl developed LabanWriter version 2, Venable and Scott Sutherland developed version 3 and Venable and Ralley are the current LabanWriter team for version 4.

- Ralley also demonstrated **LabanReader**, developed at OSU with Sheila Marion. Designed for use in the classroom to aid students learning to read scores, LabanReader gives educators the ability to "layer" a score written using LabanWriter so the user can select which layers to view. For example one might first show just the supports, and then add in the leg gestures, then arm gestures and finally the torso movement. Different colors can be selected for each layer. The idea of layers also exists in the Calaban program.

- Gábor Misi and János Fügedi (Institute of Musicology of the Hungarian Academy of Sciences, Budapest) presented their program **Labanatory**. Labanatory is also a program for producing notation with the added feature of being able to search scores for designated motifs. The program has the capacity to search for the same spatial movement with different timings and to search for the same motif performed to the opposite side. Labanatory also makes use of AutoCAD.

- Lars Wilke (Credo Interactive, Inc., Vancouver, Canada) demonstrated the Dance Notation Bureau's **LabanDancer** project. LabanDancer translates notation produced using LabanWriter into computer animation, which an animated dancer performs the movement on the computer screen. LabanDancer now has the ability to translate most of the movement concepts in the elementary notation syllabus such as steps, turns, jumps, and arm and leg gestures. The LabanDancer team includes Lars Wilke, Tom Calvert, Ilene Fox, and Rhonda Ryman.

- Lorenzo Torresani (Center for Advanced Technology at New York University, New York) demonstrated Laban Capture, NYU's new project to explore how Laban Movement Analysis (LMA) can inform motion capture data, to train computers to recognize the subtle movements people make and to produce more dynamic computer animation. The project team includes Christopher Bregler, Peggy Hackney, Lorenzo Torresani and Edward Warburton.

Discussion sessions: Needs of the field identified. Over the two days, discussions both of the group as a whole and in small, break-out groups served to identify dance research needs and technological possibilities. We reinforced the need to keep in mind the continuum of novice to expert users and the continuum of abstract to specific. We were reminded to keep in mind the needs of dance genres from around the world rather than confining ourselves to the needs of Western theatrical dance. When the needs were prioritized, the following list evolved:

- Retain our current ability to create, edit and disseminate scores.
    - facilitate preservation of the scores we have
    - make the scores we have accessible
    - create an online library of resources
        - for security have "read only" scores

- Be able to exchange information and translate between notation files, computer animation, motion capture data and video.
    - be able to transfer files between LabanWriter, Calaban and Labanatory, preserving layout and symbol choice.
    - animate and search (through animation)
    - go from video to Labanotation to an editor to clean up notation
    - make automatic rough score generation from motion capture
    - utilize motion capture data for style research, parameters of style by converting it to Labanotation so it can be studied
    - perform motion analysis and choreographic analysis
    - use as diagnostic tool for students, to see what they are doing
    - perform three dimensional movement assessment and assess movement skills
    - perform assessment—self assessment with motion capture
    - import other environments, costumes, lighting with animated dancers for pre-visualization (like movie industry)
    - be able to have multi-media scores, combining the various resources into one document

- Add the ability to search scores, using the computer to facilitate the search
    - find specific movement patterns, for example in the arms, or rhythms
    - find similar movement patterns within specified criteria, such as the same spatial movement with different timing
    - search for similar matches within a certain percentage of similarity, best match, next best match etc.
    - search movement patterns rather than symbols (for example when different symbol patterns represent the same movement)
    - search across files

- discover patterns, also called data mining, asking the computer to see what patterns it can find.

- Add diagnostic functions and spell and grammar check type functions.
  - change timing and/or scale for whole scores or sections of scores
  - change 3/4 timing to 4/4 and have the symbols adjust
  - automatically generate facing tacks after turns or circular paths
  - mechanically check scores for certain basic requirements
  - find and replace movement clusters
  - have tutorial and help functions
  - identify corrections to give the notator the option to accept suggested changes or leave the notation as is.
  - give the user the ability to turn the new features on and off as needed
  - keep a record of all changes that are made so that, for example, changes to chorography or notation usage can be identified over time

- Add features to allow for selection of parts of a score or deconstruction
  - layering – be able to get specific layers only in printout
  - deconstruct LN score, from detail to motif

- Recognition of handwritten symbols
  - scan notation created in rehearsal into the computer for translatation into computer produced notation
  - convert completed, handwritten scores into computer-generated scores.

- Have a feature that automatically generates floor plans from the notation or creates notation of supports from floor plans. (From floor plan to notation is the trickier problem.)

- Expand LabanReader
  - give the ability to strip away all but the basics
  - strip away and layer in layers of detail
  - automatically create a LabanReader document

- Expand LabanDancer adding the capacity to translate more movement concepts, longer scores, and more than one dancer

- Analyze style from the score
  - identify and analyze choreographic structure
  - compare/contrast – to identify personal style and compare/contrast choreography

- Communication mechanism, such as a web site, for developers of these or related ideas/projects.

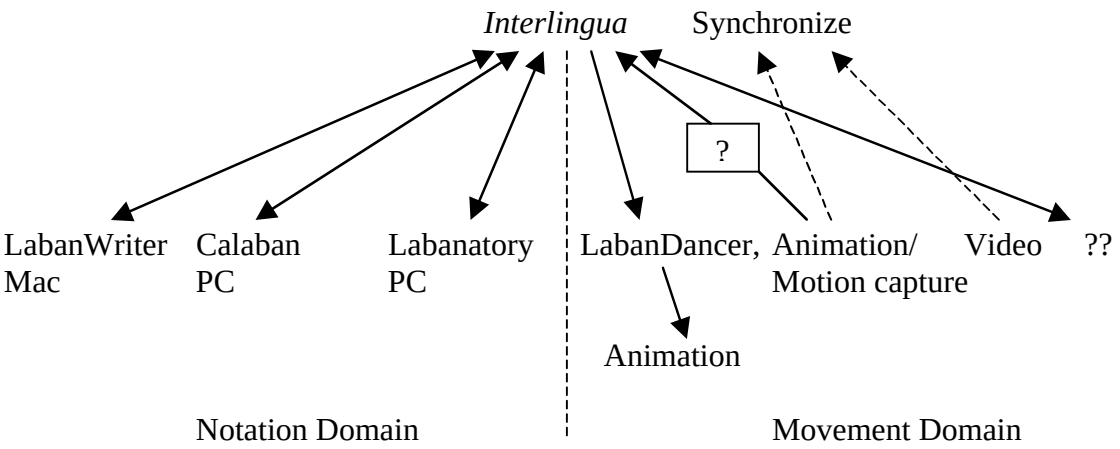
- Discussions were also focused on how to achieve these goals. Some technical concerns were raised. There is the need for:
  - agreement of file formats to exchange data
  - portability standards and file specifications
  - agreement of motion representation to exchange data
  - consistency of end products
  - consistency of how updates happen

During the discussions, two possible options for achieving our goals were identified.

Option 1: Interlingua The first option was to add intelligence to the existing programs by creating a data representation that would work with them and would contain information about the attributes of the symbols (timing, part of the body moving, relationship to other symbols, etc.). It would allow for interchange of data and be developed so that it could be used to translate data between Labanotation programs, animation, motion capture and, possibly, video. We coined the term *interlingua* for this interchange file format. With this option, we would continue to use the existing programs, Calaban, LabanWriter and Labanatory, in conjunction with the *interlingua*.

The programmer(s) for each notation program would be responsible for doing the necessary programming to allow the software to work with the *interlingua*. Using the *interlingua*, it would be possible to translate data between the various notation programs, such as from LabanWriter to Calaban. The *interlingua* would facilitate translation of Labanotation from the various notation programs to computer animation, using LabanDancer or any future animation developments. With the creation of as yet undeveloped software, it would be possible to translate motion capture data or animation to notation. It would also be useful for synchronizing animation, motion capture data and video with notation. It is possible in the future that it could also be utilized to translate video data to notation or be used with some medium that has not yet been envisioned.

A diagram was developed to represent how the *interlingua* would function:



Dashed arrow = related, not translated

?? = future developments that we have not yet envisioned.

? = translator

Option 2: A new program

In Option 2 a new program would be created to replace LabanWriter, Calaban and Labanatory. It would combine the best features of each, as well as adding new features we have now envisioned. This program would use the *interlingua* for translation between animation, motion capture and video. It would work on both PC and Macintosh. The desired features would include:

the diagnostic and search features described earlier
drag and drop
ability to modify drawing of symbols
ability to modify symbol and column widths
multiple views,
simultaneous views of different files and different measures in same file
import /export
zoom.

Conclusions The two options were evaluated as a means of achieving the identified priorities. Creating an *interlingua* to use with existing programs could meet our needs in a shorter time. Developing a new, master program to replace the existing programs is a higher risk, requiring more time and with higher development costs. However, the end-user would not need multiple programs.

It was concluded that we should select the more easily achievable goal as a starting place, focusing our initial efforts on creating an *interlingua* to use with existing programs.

A smaller working group convening on Monday was charged with taking the conclusions and priorities identified by the working group and formulating a plan to achieve these goals.

Offers: It was suggested that we create a website to link the interested community and to make our efforts visible. Scott Sutherland volunteered to look into the creation of such a website.

Norman Badler offered to take the motion capture data of Bebe Miller's *Prey*, produced at The Ohio State University's Advanced Computing Center for the Arts and Design (ACCAD) and have one of his students see what kind of rough score could be generated from the data, at least for the supports. It would then be compared with the existing Labanotation score of *Prey*, notated by Valarie Mockabee.

Monday April 26, 2004

The planning group met to discuss the conclusions of the conference and to create an action plan for working towards the goals. Present at the meeting were Thomas W. Calvert, Ilene Fox, Jonathan Hatol, Matthew Lewis, Sheila Marion, Valarie Mockabee, Maria Palazzi, David Ralley, Rhonda Ryman, Scott Selbie, Scott Sutherland, Lucy Venable, and Lars Wilke.

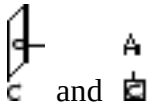
Option 2 was reviewed, and again it was confirmed that the cost and time would make creating a new, master program an unrealistic goal at this time. Remaining discussions centered on achieving the goal of Option 1, the creation of an *interlingua* to work with the existing programs and allow further developments utilizing notation and animation, motion capture data and video.

The *interlingua* was further defined. It would not be a program in itself, but something read into other programs, that is, a file format. It would contain all the information to get from one program to another. Filters would need to be created for each program that uses it. The filter would be the responsibility of the programmer(s) of each program. The *interlingua* would be a standard file format for disseminating Laban scores defined in XML. Representation in *interlingua* would have tagged knowledge of meaning, such things as what part of the body is moving, timing, location on the staff, direction, level, etc. It would probably include a set of code libraries that other applications could use to read and write files defined by the standard file format. It would define the data structures that programs would use to store Laban scores in dynamic memory while programs are running. (Note, the standard file format is used for storing Laban scores on disk or other "static" storage media). The libraries would be used by any program, such as Calaban, LabanWriter, Labanatory and LabanDancer, that wants to read or write

interlingua, The "translation" from these data structures to whatever representation the individual program needs would happen within the program.

The *interlingua* would need two parallel components: 1. it would need to be able to go from a score back to a score, a symbol based component (graphic level), 2. it would need to have some understanding of the movement taking place, a representational component (meaning level). The *interlingua* has to have fundamental ties to Labanotation, component 1, but if we want also to use it with animation, motion capture data and video it would require component 2. The two levels would have a different kind of storage. Whether it is designed as multiple files or as a single file with multiple tracks may not matter as long as it is built in a way that allows synchronization. It was suggested that there would need to be a continuum from symbolic representation to movement representation. It was also suggested that the movement-based component might need to be a little engine.

There would not be a lot of functionality built into the *interlingua*. Functionality would be a component of the notation programs themselves.

In translating from one notation program to another, the *interlingua* needs to be able to preserve layout and symbol choice. For example,  and , when resulting in the same physical action, would need to be stored differently on the graphic level, but would be stored as the same physical action on the meaning level. Stored within the symbol would need to be information on how to draw itself. The look of the score (layout and graphics of individual symbols) would need to be stored. We would need to include intelligence that will adapt symbols to create a printable score, stored as ancillary information. There should be embedded rules for how the score is to be displayed.

The *interlingua* needs to carry timing data, to allow for simultaneous display of movements which occur together, for example in translation to animation.

We need to find a balance between a concise representation and full level of detail. There may need to be compromises.

The *interlingua* needs to be able to recognize collections of symbols and understand what symbols work together as a concept or unit to give the movement message, for example, when there is a contracted arm gesture it needs to understand that the contraction symbol and arm direction need to be viewed together as a unit. Or when there is a direction half way between two directions, the direction is indicated by a cluster of symbols that are read together:  .

Intelligent data entry was discussed to address the problem of identifying symbols that should be viewed as a unit. By intelligent data entry we mean a mechanism for linking symbols as they are entered, in order to define for the *interlingua* what is to be read

together. In considering ways to implement intelligent data entry, it must be kept in mind that it is the notator's job to convey information about the dance and any system we implement must not take his/her focus away from the movement analysis.

The computer program is a tool for the notator and should not dictate how she has to notate or input data. Suggestions that were made included:

> automatically opening new menus with related symbols when a symbol is placed, for example after a turn symbol is placed, a pin menu would open automatically.
>
> placement of certain symbols would result in automatic linking and highlighting of symbols that are assumed to be associated with them. If the symbols were not to be read together, the notator would have a mechanism for breaking the link.
>
> there could be triggers to cluster symbols, and a function could be created to locate unidentified triggers.

The *interlingua* will facilitate the programming of search features. The format of the *interlingua* and what it includes will influence how we are able to search.

There is still some debate as to how much "meaning" should be incorporated into the *interlingua*. Lars Wilke, based on his experience with creating LabanDancer, the program to translate Labanotation into computer animation, feels that the representation should move away from trying to describe exactly what is on the page, to a system of symbols that correspond more closely to the Laban symbols. "Meaning" would be contained in the sense that symbols would not be ordered by their x, y coordinates, but would be associated with distinct times, durations, and body parts. There would be a distinction between symbols that represent gestures, and ones that represent supports. Whether or not modifier symbols should be stored separately along with associations, or whether modifiers would simply define attributes of the major symbols is open. In his representation in LabanDancer, Wilke did not store modifier symbols separately; he stored the information that is conveyed by the modifier as an attribute of the modified symbol. So for example, the twist symbol has an attribute called "amount", which stores how much twisting (in degrees) the symbol represents. But there may be cases where storing them separately is more advantageous.

Jonathan Hatol proposed to create what he has called a "Dance Ontology" using OWL Web Ontology Language. This is a way of storing semantics, and relationships. It is independent of how you represent Laban scores, rather, it relies on a set of "meta-data" which describe, and class individual files in an archive, thus allowing you to do more intelligent searches and other operations on your archives. It relies on the archivist/notator to enter pre-defined descriptors of each item (i.e. file) in the archive, either retroactively, or at the time of creation. This could be considered part of the

interlingua, or operate as an adjunct to it. It could work equally well with LabanWriter files as with *interlingua* files, and could work with both at the same time.

Through the use of the *interlingua* it is envisioned that we can apply concepts of Labanotation on top of motion capture data as another layer. It could provide a visualization and analytical tool for motion capture, lending high level constructs to mocap data. It could serve as a means of searching for motion capture examples in a database.

Some criteria for the *interlingua* were established:

• The result should be compatible with both Macintosh and PC's. This needs to be considered when selecting what computer language to use. Some code libraries work better cross platform than others. We do not want to be dependent on commercial products such as AutoCAD or Power Plant.

• We need to be clear on how we see the application being used; such as do we want web accessibility?

• We do not want to lose functionality.

• As we create the *interlingua* we should learn from what Lars Wilke has already done in the LabanDancer project and expand on it. We should investigate picking up his intermediate representation which uses a system of symbols that correspond more closely to the Laban symbols and which store the information that is conveyed by the modifier as an attribute of the modified symbol.

We then looked at how we could go about creating an *interlingua* that would serve our needs and how we could research its use with animation, motion capture and video. Creating an *interlingua* would require considerable funding. One concern was whether we would be able to raise sufficient funding from arts sources. It was suggested that our skills with movement analysis, as conceptualized in Labanotation, have a lot to offer the sciences. If we are able to define a project that researches how our methods can assist the sciences, using notation and technology, we could approach sources of scientific funding that have programs with larger grant levels. This would allow us to create the *interlingua* and develop its use with animation, motion capture and video, meeting the needs of the dance field at the same time as we address the sciences.

It was decided to seek funding for a collaborative project with the Dance Notation Bureau; and at The Ohio State University the DNB Extension for Education and Research in the Department of Dance; the Advanced Computer Center for Arts and Design; and possibly the Department of Engineering, with The Ohio State University as the submitting institution. Additionally, consultants would be utilized from among those participating in the conference. We would like to include the developers of Calaban and Labanatory and the LabanDancer team, among others.

We are proposing a research project to take dance knowledge of movement analysis and apply it to other fields. We are proposing to investigate how our knowledge of movement analysis with its ability to quantify movement using Labanotation can be a beneficial tool to the sciences. We will investigate how the use of technology can enhance this tool for the sciences.

Specifically, we propose to investigate the use of Labanotation as a *lingua franca* for movement, providing a universal standard for describing movement. As our first step, we propose to develop the *interlingua*, which will allow us to add meaning to movement representation, to the Labanotation symbols. We envision that it is a one-person job to come up with XML definitions, with review by a small group made up of participants from the conference. We then plan to investigate the use of the *interlingua* with the existing notation programs, with animation, with motion capture data and with video. The LabanDancer program will be utilized as proof of concept and further developed.

It is envisioned that in investigating how Labanotation can function as a tool for the sciences, we will also be developing tools that are invaluable to the dance field.

The principal investigators for the project were identified:

From OSU: Matthew Lewis, Ph.D. AACAD; Maria Palazzi, M.F.A., AACAD; Sheila Marion, Ph.D. Dance, Valarie Mockabee, M.F.A. Dance, and possibly Jim Davis Ph.D. Engineering

From DNB: Ilene Fox, BA, CMA Dance

We will investigate submitting proposals to the National Science Foundation (NSF) and the National Institute of Health (NIH). Scott Sutherland, who is now working for a hospital, suggested he might be able to provide medical collaboration. We would also like to speak with Scott Selbie, whose company works with medical professionals who need to analyze movement patterns as a diagnostic tool, about a statement of need for this kind of data.

We will also investigate other funding sources. Perhaps get pilot projects started with smaller funding. Tom Calvert will investigate Canadian sources of funding. Some other sources of funding that were mentioned included The Rockefeller Foundation, Alfred P. Sloan Foundation, and, for the writing recognition portion of our goals, both Microsoft and Apple were suggested.

Project Contacts:

Sheila Marion – marion.8@osu.edu
Ilene Fox – IleneFox@dancenotation.org

Conference Participants (in alphabetical order).

Andy Adamson, Birmingham, England: Honorary Senior Research Fellow in the School of Computer Science, University of Birmingham; programmer for Calaban, an Autocad-based program for Labanotation

Norman Badler, Pennsylvania: Professor, Computer Science and Information Department, University of Pennsylvania, and Director, Center for Human Modeling and Simulation

Marion Bastien, Paris, France: notator, multimedia specialist and web site developer; former Secretary of the International Council of Kinetography Laban. Newly appointed at Centre national de la danse for a mission on choreographic repertories

Thomas W. Calvert, Vancouver, Canada: Professor of Interactive Arts and Technology, Simon Fraser University; developer of Life Forms animation software and Technical Director, LabanDancer, animation from score project

James W. Davis, OSU: Assistant Professor, Department of Computer Science and Engineering; Faculty Member, Center for Cognitive Science; Affiliated Faculty, Advanced Computing Center for the Arts and Design (ACCAD); Research interests in computer vision for analysis and recognition of human movement and activity

Sîan Ferguson, Dublin, Ireland: former Labanotator for the Paul Taylor Dance Company, Open-Source Programmer, former Multi-media Developer, Dancer, Dance Teacher. Currently on sabbatical at Stanford University. Research interests: Social Dance Notation

Ilene Fox, New York: Executive Director, Dance Notation Bureau, notator and Project Director for LabanDancer, animation from score project

János Fügedi, Budapest, Hungary: Dance Ethnologist and Notator, Scientific Co-Worker with the Institute for Musicology of the Hungarian Academy of Sciences, on development team for a retrieval system for Labanotation to aid dance analysis

John Giffin, OSU: Professor of Dance, Labanotation teacher; research interests in notation and choreography

Jonathan Hatol, Vancouver, Canada: Graduate Student, School of Interactive Arts and Technology, Simon Fraser University; Programmer, Labanotation score editor in Java

Adrienne Kaeppler, Washington, D.C.: Dance Anthropologist and Curator of Oceanic Ethnology, Smithsonian Institute

Mira Kim, New York: Notation Associate and LabanWriter specialist, Dance Notation Bureau

Matthew Lewis,(Monday meeting only) OSU: Graphics Research Staff at the Advanced Computing Center for the Arts and Design (ACCAD); research interests in generative art, virtual environments, and digital characters

Vera Maletic, OSU: Professor Emerita, Dance; research interests in multimedia dance documentation

Sheila Marion, OSU: Associate Professor of Dance and Director, Dance Notation Bureau Extension for Education and Research; research interests in facilitating learning Labanotation through the use of computer technology

Gábor Misi, Budapest, Hungary: programmer, Institute for Musicology of the Hungarian Academy of Sciences

Valarie Mockabee, OSU: Associate Professor of Dance and notation; research interests in multimedia dance documentation and motion capture

Mervin Muller, OSU: Professor Emeritus and former Chair of Computer Information Science and Prof. of Statistics

Maria Palazzi, OSU: Director of Advanced Computing Center for the Arts and Design (ACCAD) and Associate Professor, Design; research interests in motion capture and animation

David Ralley, Petaluma, California: Programmer for LabanWriter 4.0, OSU Department of Dance

Rhonda Ryman, Toronto, Canada: Associate Professor of Dance, University of Waterloo; notation expert for LabanDancer, animation from score project

Shelly Saint-Smith (Sunday only), London, England: Assistant Director, Language of Dance Centre; freelance Labanotation teacher, dance director and notator; Calaban and LabanWriter operator

Scott Selbie, Washington, D.C: Director of Research, C-Motion Inc.. 3D motion analysis; Adjunct Professor, University of Massachusetts, Dept. of Exercise Science; and Adjunct Professor, Queen's University, Canada, Dept. of Anatomy & Cell Biology

Scott Sutherland, Seattle: LabanWriter 3.0 programmer (Pascal), and Technical Advisor for the Dance Notation Bureau

Lorenzo Torresani, New York: Ph.D. Student in Computer Science at Stanford University and member of Center for Advanced Technology at New York University; research interests in motion capture and animation

Judy Van Zile, Hawaii: Professor of Dance, University of Hawaii, Dance Anthropologist and notator with research interests in the Asian Pacific area

Lucy Venable, OSU: Professor Emerita, Dance; notator and Project Director for LabanWriter 1.0-4.5 for the Macintosh

Edward Warburton, New York: Assistant Professor and Director of Dance Education, The Steinhardt School of the Education, New York University; research interests in dance cognition and using Laban's theories with motion capture animation

Lars Wilke, Vancouver, Canada: Credo Interactive, Inc., programmer for LabanDancer, animation from score project