An Accuracy of Issue

Marcelo Leite

No one, not even a dancer would see a trace of human movement in the picture above. Yet this is the representation of the trajectory of points of the body, found in Analívia Cordeiro's studies. She researched precise notation for choreography with the aid of computer graphics. Such an unusual use of the computer, which could only be achieved after years of research and knowledge of the connection between art and technology.

Is it computer art? Not exactly. At best, it is "computer-assisted art," derived from the established applications of computer graphics design/computer-aided manufacturing (computer-aided design/manufacturing, or CAD/CAM). The computer used as a tool and not as a magical object; a multiplying factor of possibilities for creation and research.

In short, it is much more contemporary than what is implied in the pseudo-futuristic marketing imaginary of this equipment.

From a conceptual point of view, the best way to characterize human movement is utilizing trajectory-notation. This was the subject of ongoing research by dancer and choreographer Analívia Cordeiro for thirty-one years, of which at least twelve were dedicated to the study of the possibilities of using computer technology in the context of dance.

At that time, in 1973, researcher Analívia—then a student of architecture—was one of five in the world utilizing computer graphics for dance choreography. Her mentor and model was her father Waldemar Cordeiro (1925–1973), a landscape designer and a pioneer of computer art in Brazil.

Analívia's work was considerably different in that "computerized" or "digital" content was essential in determining the outcome. The result of digital processing is a set of instructions or schemes intended just for dancers and not for spectators. In this case, its access was not clear for the non-professional dancers.

Analytical Potential

Analívia has been researching a manner of notation and recording of dance movements using 3-D features of images by computer processing since 1981, on a CNPq scholarship.

She started at the Computer Center of USP (CCE–USP), where she was introduced to Nilton Lobo, an electronic engineer student. (Fig. 1) Today, Nilton is her collaborator and founded their graphic terminal business, Intergraph Systems Ltda. Her primary concern is to record dance movements so that they are readable for the dancer. According to Analívia, the more traditional alternative to dance notation is the method known as Labanotation, performed solely by half a dozen specialists worldwide—an expensive resource that only large dance companies can take advantage of. Analívia seeks to capture by computer four basic elements of dance broken down into displacement in space, body position, muscle strength, and fluency.

For this, the computer plots twenty-four points, mostly on the joints of a body image. The next step is to register the positions of each of these points at predetermined time intervals (fractions of a second) in the computer memory through a graphics board. When the sequence of movements is a historical documentation, as in the preservation of a virtually extinct Yemenite dance recorded on 8 mm film, the digitization of points can be made frame by frame by its projection on the working station.

Then each position is displayed on a 3-D program developed by Lobo. From there, the resources of the graphic station Intergraph multiply the analytical potential of this form of incipient notation: modifications or scanning, zoom effect, observation of detail, simultaneous observation of several successive positions and, especially, the turning of the figure and the plane (stage leaning towards any of the three dimensions of space).

This last feature would be the main advantage of computer notation compared to other registration processes, such as film or videotape, which display the image in only two dimensions obtained from a single point of view. Thus, many details are lost and parts hidden by other body parts. Finally, Analívia commends the fundamental characteristic of computers—memory—translated into binary code, large amounts of

these images can be easily stored on tapes or discs. The many features collected on the graphical platform are key to the best use of technology.

Form and Substance

Analívia has so far mastered “freezing” the three-dimensional positions. The process of reading a movement registered by a dancer—the most important part, according to her—is still in testing phase. It is being tested, at the moment, the possibility of representing dynamically the transition from one position to another by lines representing the trajectory of each of the twenty-four points of the body, resulting in complex images (see opening picture).

The challenge Analívia takes on is to achieve a factor that recomposes the original emotion besides the pure technical result, trying to include in these formal schemes some movement elements such as fluency and muscle strength, which inevitably are lost in the conversion from analog to digital.

One of Analívia’s arguments in defense of her method is its potential for saving time and energy in experimental choreographic composition processes, where the dancer acts “as a mere puppet” under the choreographer’s orders. With computer assistance, the choreographer could continue to create, experiment, and select sequences of movements, until two or three would be tested in practice—dispensable only at certain stages and types of choreographic creation, in her opinion.

At this point, the reasoning of the researcher follows the most common line in defense of all types of automation: relinquishing the more mechanical moments of the work in favor of those more pleasurable ones.

Incidentally, during her first experiences with choreography and computer—in the context of choreographic production for TV—her goal was to optimize the relationships between different technical teams. This initial phase of her research—conducted between 1973 and 1976 in the Computer Center of UNICAMP by the invitation of the dean Zeferino Vaz—resulted in the *M3x3*, *Gestures*, $0^{o} \Leftrightarrow 45^{o}$, and *Cambiantes* videos. These works have been presented in important computational arts shows all over the world. These videos were intended to obtain detailed choreographer instructions for

dancers, TV directors, and cameramen. Such instructions generated from programs relating relevant components of the dance and TV languages allowed the dancer to know, for example, from which angle the camera would be; the TV director and three cameramen, in turn, received precise details of the angle to be adopted (front, side, etc.), and the plane of focus.

All this justified Analívia in her article “The Programming Choreographer” (published in the magazines *Data&Ideas* 4 [Brazil], 1976, and *Computer Graphics & Art*, [California], February 1977), to circumvent the effect intended by choreographer’s messages.

On the other hand, more precise instructions than the “metaphors” usually employed by choreographers would enable staff to “self-critique” and would be more objective and referenced.

One Among the Other Half

More than to the choreographic creation, however, the computer notation would be important for preserving cultural heritage, in process of being forgotten and then lost, like a traditional dance of Yemen. The film of this dance was entrusted to Analívia. Computer notation should be enhanced with mathematical precision to record the filigree of fine, discrete, and subtle movement. This allows a combination of computer image processing, essentially analytical, and what might be called synthetic media (although, paradoxically, partial) of movement fixation, as in film and videotape.

In lucid design, the computer is put forward as a means among others to study the movement with precision, which unfolds in a series of specific tasks, as well as many others are unfolded by other technological means like videotape. But there is nothing towards making the technology a “battle flag,” “brand,” or “label”. To speak of “art and technology” is to say nothing because technology is something implicit in the day to day. Twenty years ago, the use of computer in art was out of the ordinary; now, after twenty years of experience, there is a whole theory about it.

That’s right—a matter of accuracy and memory.

Four Hands

Nilton Lobo Pinto Guedes, fourth-year electronic engineering student from the Polytechnic School and intern at Intergraph, was introduced to Analívia Cordeiro in 1981 by a professor at the Electronic Computer Center (CCE) of USP. “At first, I had no idea what she wanted but did not know how to jump out,” he confesses. Obviously, he failed, because the collaboration has lasted nearly four years, having survived the change of institution and equipment.

In CCE-USP, Lobo started researching how to transform the body plan with those twenty-four points into a 3-D image. However, soon the equipment he used —a graphic terminal connected to the PDP-11 computer—ran out of resources and had limitations. (Fig. 2) The biggest difficulty we partners faced was data entry, which would necessarily have to be done in three dimensions.

It was through Analívia’s former partner—collaborator in the times of UNICAMP Computer Center, Guillermo Barrera Fierro, now digital’s software manager—they came into contact with Intergraph.

Two years ago, before the explosion of the CAD/CAM market, they met in Intergraph—like other artists (see the January/February issue of *Iris*)—room for experiments with the company’s sophisticated graphics resource computer.

Nilton Lobo then had to learn how to master the Intergraph stations, each with two high-resolution monitors (somewhere around 1.3 million dots on the screen, four times more than a standard TV). These stations are connected to Intergraph 11/751, a VAX computer of Digital, and some plotters (tracer machines charts and drawings) Hewlett-Packard.

Within a month, he knew enough to complete a program to implement three-dimensional figures scanned in two. Sometime later, in August 1983, Lobo was invited to be an intern at the company, just in his area of professional interest: design, simulation, and implementation of electronic circuits, one of the largest CAD/CAM application areas.

Analívia continued her growing work in the field of technology with the constant support of Lobo and the company. The work division became more flexible in terms of

functions, programming, and choreography. “It should be a work in professional bases,” complains Analívia, denouncing the lack of local research of its kind in Brazil.

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A former Nieman Fellow at Harvard University (1998) and Knight-Wallace Fellow at the University of Michigan (2012), Marcelo Leite is a science and environment columnist with *Folha de São Paulo*, leading Brazilian daily newspaper. Marcelo Leite studied journalism at the State University of São Paulo (USP). He holds a PhD in Social Sciences from the State University of Campinas (UNICAMP). His major field is science and environment journalism, which led him to internships in Germany (1989) as a fellow of the Krupp Stiftung. He worked as an intern at the magazines *Bild der Wissenschaft* and *Kosmos*, as well as at the *Stuttgarter Zeitung*, and covered the reunification of Germany for *Folha de São Paulo* in Berlin (1990). He writes the blog “Virada psicodélica” (Psychedelic turnaround) for *Folha*. Psychedelics are the subject of his most recent book, *Psiconautas – Viagens com a ciência psicodélica brasileira* (Psychonauts – Trips with Brazilian Psychedelic Science), published in 2021 by Fósforo Editora.