The Value and Use of Laban Movement Analysis in Observation and Generation of Affective Movement

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This paper discusses Laban Movement Analysis (LMA) and its potential as a comprehensive and precise structure for analyzing and representing expressive movement. This can be of great use for characterizing and generating affective movement for artificial agents, such as robots, animations, kinetic sculptures and environments. In our collaborative work, “Laban Movement Analysis and Affective Movement Generation for Robots and Other Near-Living Creatures,” our goal was to generate compact, informative representations of movement to facilitate affective movement recognition and generation for robots and other artificial embodiments. We hypothesized that LMA, a systematic and comprehensive approach for observing and describing movement, is an excellent candidate for deriving a low-dimensional representation of movement that facilitates affective motion modeling.
In addition to the longstanding research on movement analysis in the dance community, affective movement analysis has more recently received significant attention in other domains. There is a large and active research effort on affective movement perception, recognition and generation in cognitive science, psychology, and affective computing.²

Daily we consciously and subconsciously interpret meaning and self-expression by observing body language of others. Our motivation for this research was the question, is it possible to translate emotional expression through an arm movement via algorithms, into a moving sculpture “with feelings”? Our inspiration was one of the immersive, responsive sculptures in a series entitled: Hylozoic Ground, by Philip Beesley and Rob Gorbet. Since people move in response to the sculpture, would it be possible to observe their movements and interact affectively through movement? This capability may be valuable beyond artistic installations, in applications such as human-computer interaction and human-robot interaction. Our goal then was to develop a way to translate between the movement language of humans and the potential movement language of the sculpture.

As a path to reach our goal, our research focused on expressive human gestures of the arm and hand, the parts of the body that would be most similar to the sculpture’s moving fronds. Each individual has a unique personal history that influences their movements, as does their physical “architecture” and ability. The challenge of this study, this partnership between the science of robotics and the art of expressive movement, was to attempt to discover and distil the essence of affective movement. The engineers looked to the dance/theatre performance world, where choreographed movements can be specific and repeatable with believable expressive qualities, for a language to analyze and describe movement.

Our approach aimed to quantify and formalize the relationship between perceived movement qualities and measurable features of movements, to enable this relationship to be exploited for automated recognition and generation of affective movement. Another challenge of our research was to develop a common language and shared understanding of movement analysis between interdisciplinary research team members from the dance/choreography and engineering communities.

“I can’t do much for you until you know how to see.”

-José de Creeft, sculptor
The study of Laban Movement Analysis (LMA) trains an observer to see, to become aware of, to attempt to ascertain the different aspects of movement. LMA promotes an understanding of movement from the inside out, as the mover, as well as from the outside in, as the observer. Rudolf von Laban (1879–1958) developed theories and systems of movement and notation. He wrote about the need to find a way to combine movement-thinking and word-thinking in order to understand the mental side of effort and action and re-integrate the two in a new form.

Laban stressed that imitation does not “penetrate to the hidden recesses” of human inner effort. Laban searched for an authentic symbol of the inner vision in order for the performer to make effective affective contact with an audience, and felt that this could be achieved only if we have learned to think in terms of movement. He developed a system of basic principles and movement language that are encompassed in today’s Laban Movement Analysis. Bloom argues “that LMA, by providing a vocabulary for articulating the detail of experiential phenomena, provides a valuable framework and a system of categories for bringing the inter-relationships between body and psyche into greater focus.” To enable automated movement analysis, a computational understanding of how affect is conveyed through movement was needed. Laban Movement Analysis was used to provide a language useful in the “translation of emotions to algorithms.”

Laban Movement Analysis is divided into four overarching themes, both quantitative and qualitative. They comprise a blend of science and artistry. Stability/Mobility describes the natural interplay of components of the body that function to allow the full scope of human movement and balance to occur. Exertion/Recuperation speaks to the rhythms and phrasing of movements, that, similar to the rhythms of breath, may be said to create a “dance” between muscular tension and release. Inner/Outer addresses our connection from our needs and feelings within ourselves to our movement out in the world and the return flow of a response to our environment. Function/Expression differentiates between the aspects of movement that serve a need and the movement qualities that are expressive of affect. The latter two themes were of most interest to this project.

There is some discussion amongst Certified Movement Analysts (CMAs) concerning the dichotomy between quantitative and qualitative analysis, assuming that concepts need to belong in one category or the other.
The implication is that if something cannot be measured then it is qualitative and unprovable. The concepts in LMA are governed by principles, whether or not they are measurable, that Kagan asserts make them “concrete, observable, experientially verifiable, repeatable and predictable.” For this reason, we believe LMA is amenable to computational analysis and can be related to measurable features of movement.

Laban Movement Analysis employs a multilayered description of movement, focusing on the components: Body, Space, Effort and Shape. Body indicates the active body parts, and the sequence of their involvement in the movement; Space defines where in space the movement is happening, the directions, spatial patterns and range; Effort describes the inner attitude toward the use of energy; and Shape characterizes the bodily form, and its changes in space. If each of these aspects is understood in terms of its own integrity, one can begin to comprehend how each interacts and illuminates the others. Irmgard Bartenieff (1890–1981), a colleague of Laban, advocates the use of Effort and Shape as a means to study movements from behavioural and expressive perspectives. Application of the concepts of quality, or “inner attitudes towards” movement, are used in the analysis of Effort. Thus among Laban components, Effort and Shape were the most relevant for our specific study.

The members of our research team, in order to communicate, needed to become familiar with each other’s language, e.g., the terms “High Level-Low Level” for the engineers referred to qualities of information, but to the choreographer and actor referred to placement in space. Symbols are international in a way that words are not. Laban’s terminology and symbols become meaningful with the consciously experienced three-dimensional sculptural movements. For examples of the symbols employed in this research, please refer to our chapter 1.

In designing the movement pathways, inspiration was taken from the types of movements similar to those of the fronds in the sculpture. The goal in designing the choreographed pathways was to choose several simple arm movements that were not already strongly weighted with affect, but were as neutral as possible. It is important to reinforce the fact that different factors such as culture, physique, personal history, and specific environmental circumstances influence a quality of movement. North states that “[i]t is impossible to say either that a particular movement equals a special quality or that a particular quality equals one movement pattern plus a certain shape or space characteristic.
Only generalizations can be made, because a movement assessment is made by the meticulous study of observed movement patterns of each individual.”

Based on the study of gestures and accompanying experimentation, three simple pathways were chosen; each was also reversed, making a total of six pathways without strong affective associations. The more limited the prescribed pathway the higher the possibility of measuring subtle significant differences between the emotions. For each of the six paths, a professional actor was asked to act each of Ekman’s original Six Basic Emotions: anger, happiness, disgust, sadness, surprise and fear. Prinz acknowledges that they have become the most widely accepted candidates for basic emotions, both psychologically and biologically. In LMA, the word “intent” is used to describe part of the preparation stage of movement and Hackney states “it is at this crucial point that the brain is formulating (even in a split second) the motor plan which will eventually be realized in action.” As noted in Psychology of Dance, the more vivid, realistic and detailed the image is, the more the senses, thoughts and emotions are involved. The actor relied on her rigorous training in the use of memory and imagination to freshly create and express the emotion aroused internally.

With five tries for each emotion, we captured 180 movement sequences (6 paths, 6 emotions, 5 trials) for each of three data sets. The actor filled out a questionnaire rating her feeling of success at embodying the specific emotion for each try. The training of the actor, the number of tries, and the actor’s questionnaire, were attempts at providing high quality motion capture examples of the six emotions.

A coding sheet was devised for the Laban Certified Movement Analyst (CMA) to use while watching the video of each movement. The first LMA factor quantified was Weight Effort, which describes the sense of force of one’s movement, with the contrasting elements Strong and Light. The second LMA factor quantified was Time Effort, which describes the sense of urgency, with the contrasting elements Sudden and Sustained. The third LMA factor quantified was Space Effort, which describes the attention to surroundings, with the contrasting elements Direct and Indirect. The fourth LMA factor quantified was Flow Effort, which describes the attitude towards bodily tension and control, with the contrasting elements Bound and Free. The final LMA aspect considered was Shape Directional, which defines the pathway to connect to or from the demonstrator with their goal in space, with the two categories of Arc-like and Spoke-like.
The proposed quantifications were evaluated by comparing the automated quantification values with the annotations provided by the CMA. The results showed a strong correlation between results from the automatic Laban quantification and the CMA-generated Laban quantification of the movements. Based on this, we described in our chapter an approach for the automatic generation of affective movements.

In conclusion, Laban Movement Analysis offers a concise, comprehensive structure for observing, analyzing and representing movement, which can be of great use for generating affective movement for artificial agents, such as robots, kinetic sculptures and environments. Our approach for quantifying LMA components from measurable movement features, and using the proposed quantification within an expressive movement generation framework allows movement paths to be imbued with target affective qualities, a first step towards more expressive human-machine interaction.

In the future, a relatively new academic discipline, Sensory Anthropology, that focuses on how cultures stress different ways of knowing through brain/body maps and the senses, might benefit from further investigation of the perception and generation of affective movements. We aim to explore the other datasets collected, where the hand, fingers and arm were not confined to specific pathways. The knowledge gleaned from further research could be used for the development of kinetic affective sculptures and environments.
Endnotes

This paper is an example illustrated from our collaborative work, “Laban Movement Analysis and Affective Movement Generation for Robots and Other Near-Living Creatures.”


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