
Augmented dance scholarship: computer-assisted analysis of Javanese dance

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This case study of Javanese dance argues that biomechanical analysis of dance can be used to augment dance scholarship: quantitative biomechanical data can complement rather than supplant other kinds of dance scholarship. In proposing this, we draw a parallel to the vision of computer-assisted-literary criticism presented by Sinclair and Rockwell (2016), where interpretive textual analytics enable different readings of a text or corpus, rather than a quest for scientific truth. Similarly, we suggest that the visualization of biomechanical data enables other ways of looking at dance.

Our research project continues a long history of recording dance movements, but also departs from previous projects in important ways. Different notation systems, recording media and technological tools have been developed in order to capture the fleeting quality of dances. A few well-known examples include Eadweard Muybridge's photographic series depicting dance movements in the 19th century, the Labanotation system developed by Rudolf von Laban in the early 20th century and the application of biomechanics to study ballet in the 1970s, as exemplified by the papers in the conference *At the Dance: Verities, Values, Visions: Binational Dance Conference* in Waterloo, Ontario in 1971.

The practical applications of these systems and methods have been justified along several lines: the transmission of choreographies, dance pedagogy, description and classification of dance movements, and injury prevention. Initial enthusiasm for the scientific study of dance waned after the 1970s and has had little impact in mainstream dance scholarship. Recording of

choreographies using Labanotation and motion-capture devices are still very common, but the quantitative analysis of the data obtained in this way is not.

In a parallel development, choreographers and dance collectives often use dance-tracking systems and visualizations as part of their work; notable examples of such practitioners include William Forsythe, Siobhan Davis, Merce Cunningham, Anne Teresa De Keersmaeker and BADco. Unlike the quantitative studies of dance, these creative uses of dance data within performances are widely celebrated within dance scholarship and practice (Bleeker 2016). These playful uses of data and visualization are mostly constrained to creative dance practice. Even if they are often discussed within dance scholarship they are not often deployed as analytical approaches within dance scholarship. Our present study shows a way in which this could change.

Combining methods from dance ethnography and biomechanical engineering, we recorded differences in the building blocks of a well-known Javanese dance: *Sendratari Ramayana*. The *Sendratari* (often translated as ballet) is a modern Indonesian dance practice that combines movement gestures from royal dance traditions (*beksa* and *srimpi*), and from classical operatic dance-dramas (*wayang wong*) in order to present stories from the Ramayana (the Sanskrit epic that provides narrative background for many performance forms in South and Southeast Asia). We were interested in the "body types", a series of rules that describe how the main five types of characters should move: *luruh* (extremely refined), *lanyap* (vigorous-refined), *gagah* (vigorous), *raksasa* (ogres), *wanara* (simians), and *manuk* (birds). These rules define the rhythm and body angles at which the same movements (standing, walking, fighting, etc.) are performed by each character.

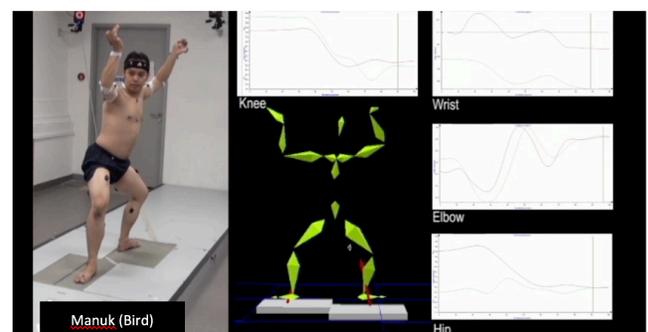


Figure 1. The dancer performs the standing motion corresponding to a bird. The movement can be seen as an animation of all major limbs and as graphs charting the movement of each joint through time.

For our study, we placed markers in all major joints of a professional dancer and we asked him to perform all basic movements as would befit each body type. Using the resulting data, we calculated the range of motion for each joint (difference between the maximum and the lowest angles). By comparing the ranges of motion pertaining to different body types, we discovered that the more subtle, elegant body types have the biggest range of motion. This is surprising even to experienced dance scholars. The demons and monkeys hold their arms in wider gestures and it would be easy to conclude that they have wider ranges of motion. The movement of the refined characters is slower and one can easily lose track of the fact that these movements actually require a greater range of motion. Indeed, similar assertions are absent in the literature. Our goal is to present our results through two interactive web displays:

- As a series of video panels, where a user can see a particular movement performed by a particular body type. Different videos can be displayed together: a recording of the dancer, an animation showing the position of the markers, and animated graphs that show the movement of specific joints (Fig. 1).
- Graphs that show a comparative overview of all movement types. For example, using Principal Component Analysis (a method often used in textual scholarship in the DH), we generated a comparison of the different body types (Fig. 2).

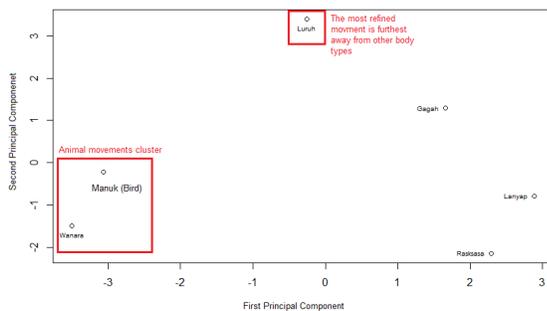


Figure 2. Principal Component Analysis of the ranges of motion of the main body types.

These results are not only aimed at a quantitative validation of scientific premises: their key contribution to dance scholarship is that they can help us look at dance differently. Borrowing a term from Sinclair and Rockwell, we describe our visualizations and

graphs as hermeneutica, interpretive toys that can change how a scholar looks at a particular cultural practice (dance in our case, text in theirs). Like them, we see our results “not as microscopes revealing the inner structure, but as augmentations adding to a history of interpretation” (Sinclair and Rockwell 2016: 101). Rich, qualitative descriptions of “body types” across multiple Javanese art-forms (puppetry, dance and dance-dramas) are available in previous dance scholarship and in ethnographies of Java. Dancers and scholars have developed evocative metaphors to describe the qualities of movement.

Our study constitutes the first systematic measurement of the differences among “body types” in Javanese dance but its goal is not to disprove previous scholarship. Our main interest is to explore how visualizations of our research data can be used to help scholars look at dance differently. We suggest a way forward for dance scholarship where interactive displays allow multiple ways of understanding dance, at the crossroads of ethnography, dance criticism and quantitative biomechanical analysis.

Bibliography

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