

# Motion Comics: Visualization, Browsing and Searching of Human Motion Data

Myung Geol Choi<sup>1</sup>

Kyungyong Yang<sup>2</sup>

Jehee Lee<sup>2</sup>

Jun Mitani<sup>1,3</sup>

Takeo Igarashi<sup>1,4</sup>

JST ERATO IGARASHI Design Interface<sup>1</sup> Seoul National University<sup>2</sup> University of Tsukuba<sup>3</sup> The University of Tokyo<sup>4</sup>

## 1 Introduction

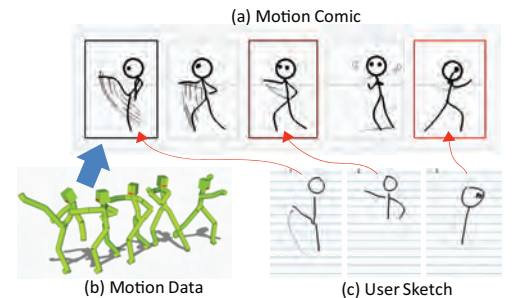
The use of motion capture data is becoming popular not only for graphics researcher and developers in industry but for common graphics application users. Recently large motion databases are publicly available on the web [CMU-Graphics-Lab 2003]. *Second Life* [2003] allows its users to animate their virtual characters by using their own collection of motion data. Even with the proliferation of motion data, searching a desired fragment of motion data from a large data repository is still challenging because of the lack of appropriate user interfaces.

A brief description or keyword annotated by the one who acquired motion data might be helpful to some extent. However, text annotation could be subjective and often insufficient for describing the content, style, context, and nuance of human motion. One automated solution is to pick out and display a number of distinctive frames of motion data [Assa et al. 2005]. This approach efficiently visualize significant moments of motion data but has some limitation to explain overall story of the motion. In addition, it would be difficult to provide a proper search method or interface for the end-users.

We introduce a comic-based interface for visualizing, browsing and searching human motion data. A comic is a medium which delivers a story with a sequence of images. The power of comics is in its ability to convey dynamic and temporal information in an abstract form. A small collection of comic-style images can express much information, such as spatial movements, passage of time, the interaction between characters, and their emotional states. Specifically, we aim two goals: One is visualizing motion capture data in a comic style and the other is searching motion data using comic-style sketch queries (see Figure 1).

## 2 Generating Motion Comics

The comic-style visualization of motion data, called *motion comics*, generates a sequence of comic panels to capture the key moments of motion data. In human motion, the velocity (and kinetic energy) of joints decrease in a moment, when they change the direction of their movement or stop the motion. Therefore, the motion between two neighboring local minimums of the speed would be monotonic in most cases that can be easily inferred from two keyframes at both ends. Thus, we separate the motion at these points. Each motion segment constructs each panel of the motion comics. First we draw the keyframe (the last frame) of a segment in the corresponding panel then add cartoonish signs that explain more details of the motion where it is necessary. For the joints whose maximum kinetic energy exceed predefined threshold, we draw a thin line or multiple lines along the trajectory of the joints to help viewers understanding of the motion speed. For the camera of each panel, we select the viewing angle that maximizes the spatial variance of important components (body joints at the key pose and the sampled points of trajectory and speed lines) in the motion segment on the 2D plane. Finally, for more compact representation, we detect a series of panels repeating similar motion (e.g. locomotion) and leave one panel among them.



**Figure 1:** Motion comics for visualizing motion data and sketch-based motion query. Motion comic (a) is generated from the motion data (b), which can be retrieved by incomplete user sketches (c).

## 3 Searching Motion Comics

Sketch-based motion query and comic-style motion visualization are inverse problems to each other. Two problems are mutually reinforcing each other because the important features of comic-style visualization, such as stick figures, trajectory/speed lines, and dividing panels, can be also used for sketching queries. The unique aspect of our context-based query interface is that it allows partial drawings to be used to search fullbody motion data. The user may focus on sketching of his/her interests, for example gaze direction, and leave the other parts unspecified, for example without arms and legs (see upper-right in Figure 1).

We compute a feature vector for the user's input sketch and compare it against a feature vector computed for a panel in motion comics. If the input sketch is incomplete, the system enumerates all possible joint label assignments and computes a feature vector for each assignment. The system then generates an equivalent set of feature vectors for each panel in motion comics. Our feature vector consists of two components, one for bone orientations and one for trajectory patterns. The system takes one or more comic panels drawn by the user and returns a sequence of comic panels from the database that matches to the user input.

## 4 Conclusion

To demonstrate the effectiveness of our approach, we built a collection of motion comics from more than one hundred motion data capturing a diversity of human behaviors. In our simple user test of the sketch-based search, the participants mostly found out their desired motions with only simple and incomplete posture inputs.

## References

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