A Choreographic Authoring System for Character Dance Animation Reflecting a User's Preference

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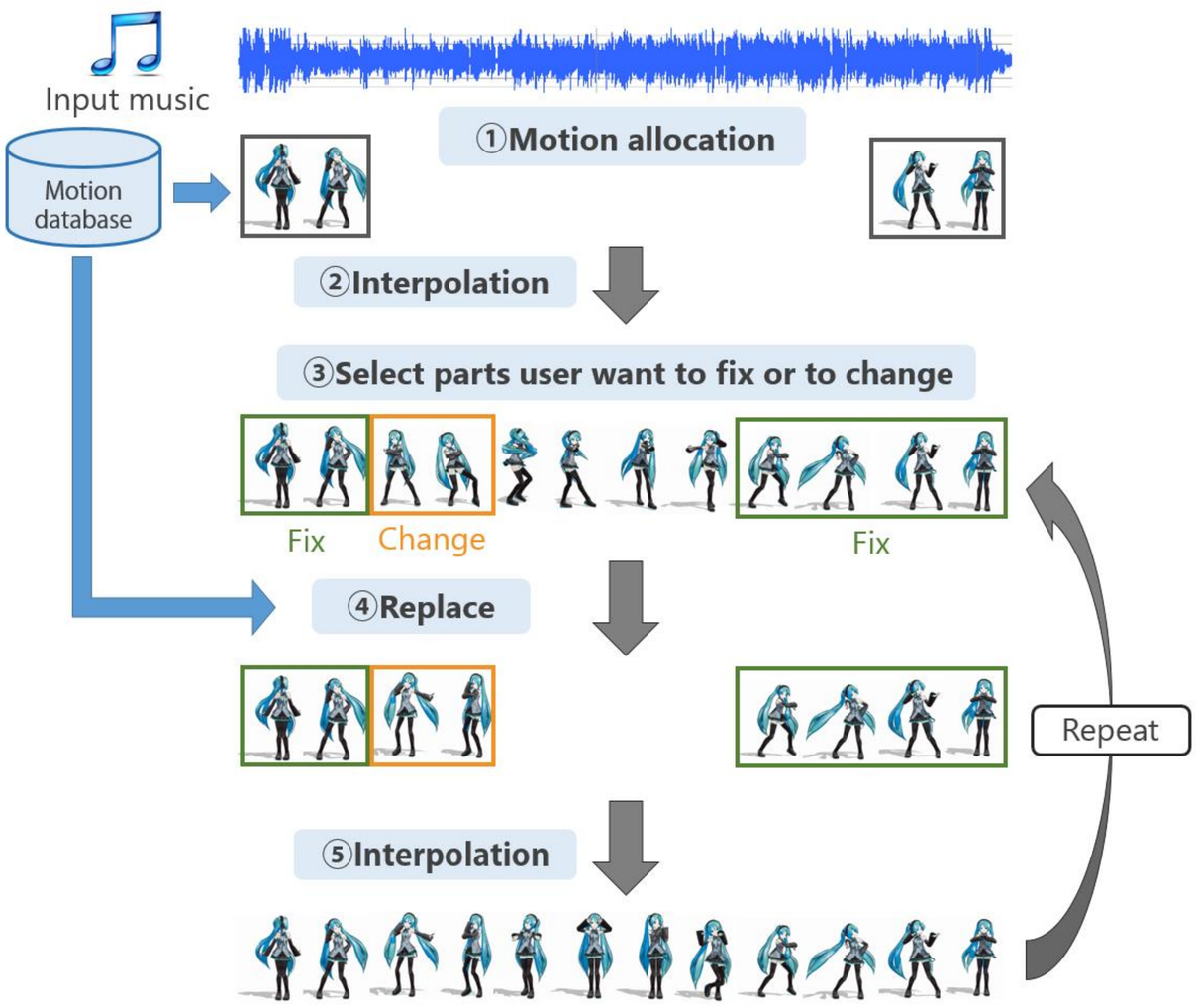
Goal

To realize a choreographic authoring system for character animation reflecting a user's preference with less burden for him/her.



Introduction

◆ We focus on two issues:

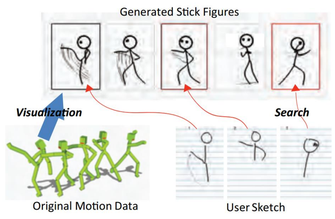
① How can we enable a user to easily search for his/her preferred motion?

② How can we semi-automatically synthesize a sequence of dance?

◆ Related work

① Motion retrieval

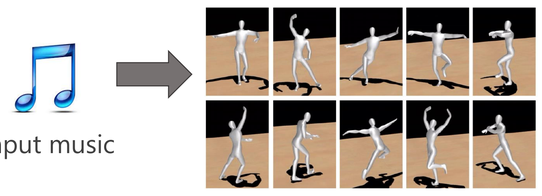
Input: Motion Data
[Michalis et al. SCA2011]



Input: User Sketch
[Choi et al. PG2012]

A large burden is often placed on the user.

② Dance motion synthesis



Input music

[Shiratori et al. EG2006]

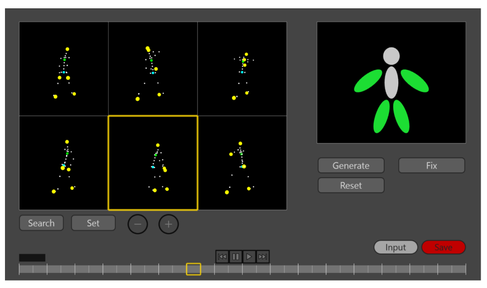
This cannot automatically synthesize a sequence under the constraint condition that the motions touched by the user are fixed.

Dance Search System

◆ Dance search system design

✓ User can see sequence candidates on a screen and simply choose preferred one.

✓ User can also re-retrieve motion data using relevance feedback based on the diversification framework. [Dou et al. WSDM2011]



Example of interactive sequence selection

Automatic Synthesis of a Dance Sequence

How are sequence candidates selected by the system?

The $(n+1)$-th motion segment is given by

$$m_{n+1} = \underset{m \in R \setminus S_n}{\operatorname{argmax}} [\rho \cdot rel(q, m) + (1-\rho)\Phi(m, S_n, L_l)]$$

Relation between a candidate segment m and the corresponding music part q

- Music Feature
  RMS mean of each musical bar
- Motion Feature
  Motion intensity W defined as the linear sum of approximated instantaneous speed calculated from the position of the joints

$$W(f) = \sum_i \alpha_i \cdot \|\dot{\boldsymbol{x}}_i\|$$

Control the variety of candidates

$$\Phi = \tau \cdot \min\{D(m, m_i) | m_i \in S_n\}$$

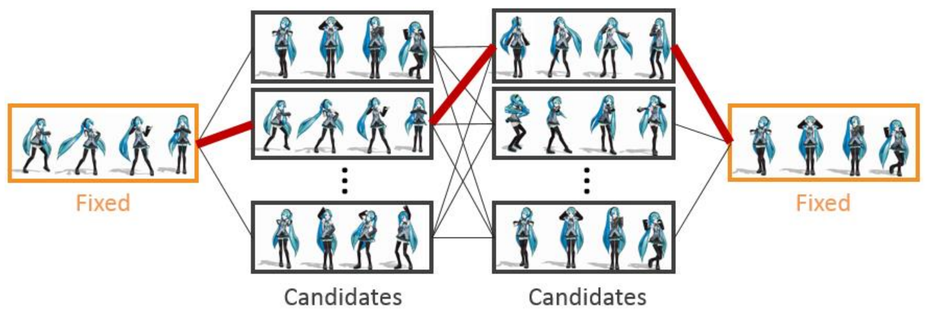
$$+(1-\tau) \cdot \max\{Sim(m, m_j) | m_j \in L_l\}$$

As the number of re-retrieval is increased, τ is decreased.

ρ : parameter that controls the tradeoff between $rel(q, m)$ and $\Phi(m, S_n, L_l)$
α_i: regularization parameter for the i-th joint
$\boldsymbol{x_i}$: position of the i-th joint

S_n: set of motion segments already posted by the system
L_l: set of motion segments the user liked
$D(m, m_i)$: dissimilarity between m and m_i (calculated by [Wang et al. 2014])
$S(m, m_j)$: similarity between m and m_j (calculated by [Wang et al. 2014])

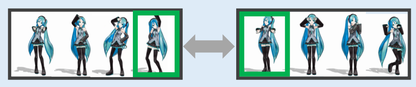
Minimization of the total costs by using Dijkstra's algorithm



1. The rhythm of candidate dance motion segments is synchronized to that of input music by resizing of motion segments.
2. The filling clips are selected by minimizing the total cost functions

$$C(A, B) = 1/(S_{pose} + S_{move})$$

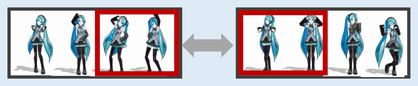
Posture Similarity



$$S_{pose}(i^A, j^B) = \sum_l w_l \left(h(\mathbf{v}_l(i^A)) \cdot h(\mathbf{v}_l(j^B))\right)$$

$\mathbf{v}$: link direction vector
i^A: frame number of segment A
j^B: frame number of segment B

Movement Similarity



$$S_{move}(i^A, j^B) = \sum_l w_l g[h(\mathbf{v}_l(j^B) - \mathbf{v}_l(i^A)) \cdot h(\dot{\mathbf{v}}_l(i^A))] \cdot g[h(\mathbf{v}_l(j^B) - \mathbf{v}_l(i^A)) \cdot h(\dot{\mathbf{v}}_l(j^B))]$$

h : through h, an input vector $\boldsymbol{a}$ is converted to the unit vector $\boldsymbol{a}/|\boldsymbol{a}|$
g : through g, $g[x] = x$ if $x > 0$, and $g[x] = 0$ otherwise

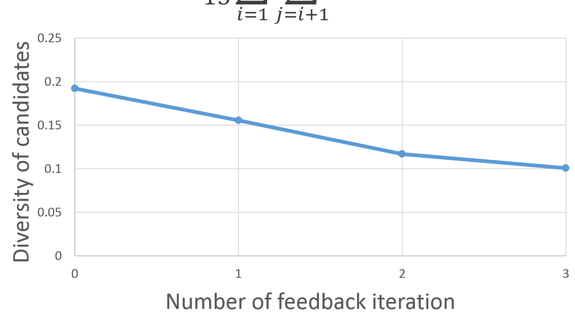
3. The resulting motion sequence is acquired by connecting the motion segment sequence using cubic interpolation.

Result and Conclusion

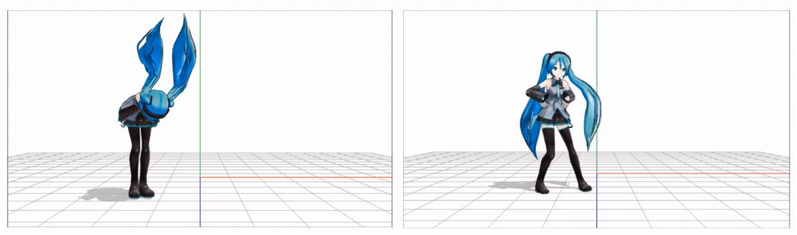
◆ Diversity of candidates

We defined the diversity of candidates as the mean of dissimilarities between each pair of six sequence candidates.

$$\frac{1}{15}\sum_{i=1}^{5}\sum_{j=i+1}^{6} D(m_i, m_j)$$



◆ Resulting dance animation



Not considering the connectivity | Our method

In the dance animation synthesized without considering the connectivity of the motion segments, character's posture rapidly changes across junctions between motion segments.

◆ Conclusion

✓ The variety of candidates gradually converges as the number of feedback iteration is increased.

✓ Our system can automatically synthesize a sequence of dance by analyzing the connectivity of the motion segments.

✓ By this system, we can create a new dance performance for character animation reflecting a user's preference.

◆ Future work

✓ A closer evaluation of usability of our system.