

the composed models, the joint locations of the underlying human parts were identified. Our physics-based algorithm couples the processes of segmentation, shape and motion estimation. This coupling produced very encouraging results on the decomposition and the estimation of shape of motion of the human parts without the need for a prior model or markers.

## Appendix

In this section, first we will present the values of the  $I_0, J_0, I_1$  and  $J_1$  for the four different cases of composition. Then, we will define the linear functions that allow mappings between intervals.

The values of the  $I_0, J_0, I_1$  and  $J_1$  for the four different cases of composition are the following:

$$\begin{aligned} \text{Case I: } I_0 &= \{C_0(v_0) : v_0 \in (v_{0,A}, v_{0,B})\}, \\ J_0 &= \{C_0(v_0) : v_0 \in [v_{0,B}, \pi] \cup [-\pi, v_{0,A}]\}, \\ I_1 &= \{C_1(v_1) : v_1 \in [v_{1,B}, \pi] \cup [-\pi, v_{1,A}]\}, \\ J_1 &= \{C_1(v_1) : v_1 \in (v_{1,A}, v_{1,B})\}. \end{aligned} \quad \text{and}$$

$$\begin{aligned} \text{Case II: } I_0 &= \{C_0(v_0) : v_0 \in (v_{0,B}, \pi) \cup [-\pi, v_{0,A}]\}, \\ J_0 &= \{C_0(v_0) : v_0 \in [v_{0,A}, v_{0,B}]\}, \\ I_1 &= \{C_1(v_1) : v_1 \in [v_{1,A}, \pi] \cup [-\pi, v_{1,B}]\}, \\ J_1 &= \{C_1(v_1) : v_1 \in (v_{1,B}, v_{1,A})\}. \end{aligned} \quad \text{and}$$

$$\begin{aligned} \text{Case III: } I_1 &= \{C_1(v_1) : v_1 \in [v_{1,B}, v_{1,A}]\}, \\ J_1 &= \{C_1(v_1) : v_1 \in (v_{1,A}, \pi) \cup [-\pi, v_{1,B}]\}, \end{aligned} \quad I_0 \text{ and } J_0 \text{ are the same as case I.}$$

$$\begin{aligned} \text{Case IV: } I_1 &= \{C_1(v_1) : v_1 \in [v_{1,A}, v_{1,B}]\}, \\ J_1 &= \{C_1(v_1) : v_1 \in (v_{1,B}, \pi) \cup [-\pi, v_{1,A}]\}, \end{aligned} \quad I_0 \text{ and } J_0 \text{ are the same as case II.}$$

In the following, we will define linear functions that allow mappings between intervals. Let  $A = [a_b, a_e]$ ,  $B = [b_b, b_e]$ ,  $C = [c_b, c_e]$  and  $D = [d_b, d_e]$  be four continuous intervals with corresponding lengths  $l_A = (a_e - a_b)$ ,  $l_B = (b_e - b_b)$ ,  $l_C = (c_e - c_b)$  and  $l_D = (d_e - d_b)$ .

• To linearly map  $A$  to  $C$ , we define the function  $f_1: A \rightarrow C$  such that:

$$f_1(x) = \left(\frac{l_C}{l_A}\right)x + \frac{a_e c_b - a_b c_e}{l_A}$$

• To linearly map the union  $A \cup B$  (assuming that  $a_e \neq b_b$ ) to  $C$ , we define the function  $f_2: A \cup B \rightarrow C$  such that:

$$f_2(x) = \begin{cases} c_b + \lambda(x - a_b) & x \in A \\ c_b + \lambda l_A + \lambda(x - b_b) & x \in B \end{cases}$$

where  $\lambda = \frac{l_C}{(l_A + l_B)}$ .

• To linearly map  $A$  to the union  $B \cup C$  (where  $b_e \neq c_b$ ), we define the function  $f_3: A \rightarrow B \cup C$  such that:

$$f_3(x) = \begin{cases} b_b + p(x) & p(x) < l_B \\ c_b - l_B + p(x) & p(x) \geq l_B \end{cases}$$

where  $p(x) = \lambda(x - a_b)$  and  $\lambda = \frac{(l_B + l_C)}{l_A}$ .

• To linearly map the union  $A \cup B$  to the union  $C \cup D$ , we define the function  $f_4: A \cup B \rightarrow C \cup D$  such that:

$$f_4(x) = \begin{cases} c_b + p(x) & p(x) < l_C \\ d_b - l_C + p(x) & p(x) \geq l_C \end{cases}$$

where the function  $p(x)$  is defined as:

$$p(x) = \begin{cases} \lambda(x - a_b) & x \in A \\ \lambda(x + l_A - b_b) & x \in B \end{cases}$$

and  $\lambda = \frac{(l_C + l_D)}{(l_A + l_B)}$ .

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