Interaction Motion Retargeting to Highly Dissimilar Furniture Environment

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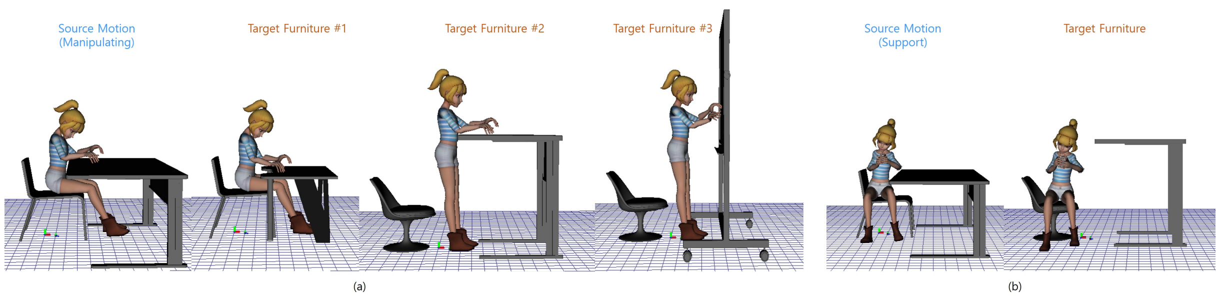

Figure 1: Example results of our manipulation-aware motion retargeting method. Both poses in (a) and (b) are in contact with the chair and the desk. (a) If a motion is recognized as manipulating interaction, a new pose is generated to preserve the contact with a task plane while giving up contacts with other furniture (chair in this example) if necessary. (b) If the motion is not manipulating interaction, the support contact is preserved while ignoring auxiliary contacts (between the elbow and desk).

ABSTRACT

Retageting a human-environment interaction motion to a different environment remains as an important research topic in computer animation. This paper introduces a novel method that can retarget an interaction motion to highly dissimilar environment, where not every contact in the source environment can be preserved. The key idea of the method is to prioritize the contact and preserve more important contact while sacrificing other contacts if necessary. Specifically, we propose a method to detect a manipulation contact and preserve the contact in the target furniture environment by allowing for a large deviation from the input pose.

CCS CONCEPTS

• **Computing methodologies → Animation**.

KEYWORDS

Human-environment interaction, motion retargeting, character animation

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1 INTRODUCTION

Adapting a human-environment interaction motion to a different environment has been an interesting research problem in computer animation, and the difficulty of the problem increases with the dissimilarity between the two environments [Kim et al. 2016]. An efficient approach is to identify correspondence between sample points on the source and target environments, and find the pose in the target environment that best preserves the spatial relationship between the input pose and the sample points on the source environment to the target environment [Al-Asqhar et al. 2013; Jo et al. 2015]. A recent study proposed a method to find new contacts if a retargeted pose is physically unstable [Tonneau et al. 2016].

In this work, we propose a novel motion retargeting method that can deal with a case that not every contact can be preserved in the target furniture environment due to the high dissimilarity between the two environment. The key idea of the method is to prioritize the contact and preserve more important contact while sacrificing other contacts if necessary. Specifically, we propose a method to detect a manipulation contact, which is considered most important among all contacts, and preserve the contact in the target furniture environment by allowing for a large deviation from the input pose. Important components to realize this prioritized contact preservation are a manipulation classifier and reference pose generator, which are realized by training a SVM classifier and a multi-layer perceptron regressor, respectively.

2 METHOD

Figure 2 shows the overview of our method. Given an interaction pose of a source character and furniture, our method first classifies manipulating interaction by using a learned classifier. For a manipulating interaction, our method generates a reference pose suitable

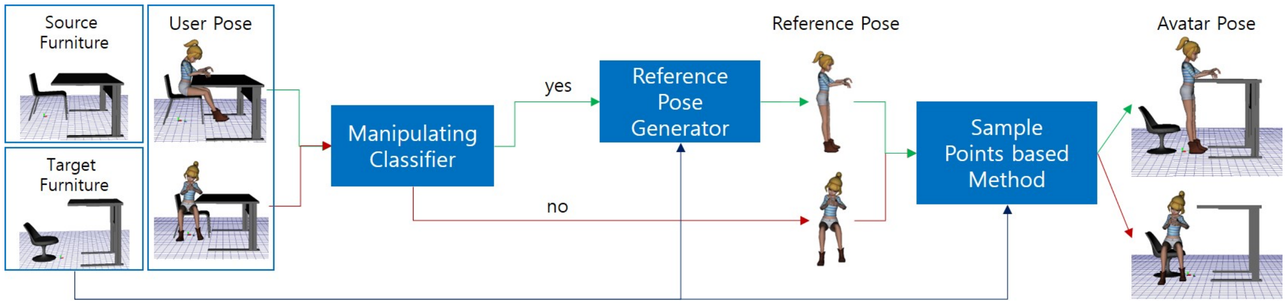

Figure 2: Overview of our method. Given an interaction motion, our method recognizes whether it is a manipulating interaction or not. For a manipulating interaction, a reference pose appropriate for the target furniture is generated. For a non-manipulating motion, the source pose is used as the reference pose. From the reference pose, avatar pose is generated for the target furniture to preserve the spatial relationship between the sample contact points on the furniture and the character by using the method of [Al-Asqhar et al. 2013].

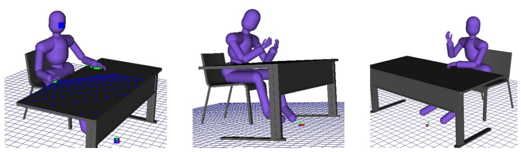

Figure 3: Rays that represent a visual field (left). Examples of manipulating interaction (middle) and non-manipulating interaction (right) used in the training data.

for the target furniture. On the other hand, if the input pose is not a manipulating interaction, the source pose is just used as the reference pose. The reference pose will then be modified to preserve the spatial relation between the pose and the source furniture to the target furniture. The spatial relationship between a pose and furniture is represented with a joint's position with respect to a set of sample points on the furniture. Refer to [Al-Asqhar et al. 2013] for the details of the sample point-based retargeting. This article only describes the manipulation classifier and the reference pose generator.

2.1 Manipulation Classifier

We train a C-SVM classifier to detect manipulating interaction. Inputs to the classifier are 1) the ratio in the visual field of the character occupied by the desk, 2) the average distance between the head and the visible area of the desk, and 3) the vertically projected area of character's body to the desk. The visual field is modeled as sample rays from the center of the head as shown in Fig. 3. We collected 12 types of interaction motions to train the classifier (Fig. 3). A total of 784, 3136, and 2043 poses were used for validation, training and testing, respectively. The error rate was 0.04 with radial basis kernel and parameters obtained by 10-fold cross validation.

2.2 Reference Pose Generator

A reference pose generator was trained to generate a natural human pose for a given target task plane. To collect the example poses, we captured poses of 10 participants by increasing the desk height by an equal interval. We then identified three features that represent human pose. These include the pelvis position, the position of the foot with respect to the pelvis, and the direction of trunk joints with respect to the pelvis. We trained a regressor to generate these three features corresponding to the inputs, which are the position and normal direction of the task plane, and the angle between the normal of hand and the normal of the task plane. The regressor was implemented with a multi-layer perceptron with one hidden layer of five cells. Given a target task plane, forward kinematics and inverse kinematics are used to determine a reference pose from the features generated by the regressor.

3 CONCLUSION AND FUTURE WORK

We proposed a method to retarget avatar-furniture interaction motion to a highly dissimilar furniture by selectively preserving contact for manipulation while sacrificing other contacts if necessary.

Our method is applicable only when the correspondence between sample points on the corresponding furniture objects is given. Automatic construction of the sample points and their correspondence, as well as automatic identification of a task plane on furniture will greatly expand the utility of our method. Our motion retargeting method allows a large deviation of the retargeted motion from the original motion, and thus it is necessary to create a natural transition motion from a given pose to the new retargeted pose. This also remains as future work.

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REFERENCES

Rami Ali Al-Asqhar, Taku Komura, and Myung Geol Choi. 2013. Relationship descriptors for interactive motion adaptation. In *Proceedings of the 12th ACM SIGGRAPH/Eurographics Symposium on Computer Animation*. ACM, 45–53.

Dongsik Jo, Ki-Hong Kim, and Gerard Jounghyun Kim. 2015. SpaceTime: adaptive control of the teleported avatar for improved AR tele-conference experience. *Computer Animation and Virtual Worlds* 26, 3-4 (2015), 259–269.

Yeonjoon Kim, Hangil Park, Seungbae Bang, and Sung-Hee Lee. 2016. Retargeting human-object interaction to virtual avatars. *IEEE transactions on visualization and computer graphics* 22, 11 (2016), 2405–2412.

Steve Tonneau, Rami Ali Al-Ashqar, Julien Pettré, Taku Komura, and Nicolas Mansard. 2016. Character contact re-positioning under large environment deformation. In *Computer Graphics Forum*, Vol. 35. Wiley Online Library, 127–138.