

Environment-Adaptive Contact Poses for Virtual Characters

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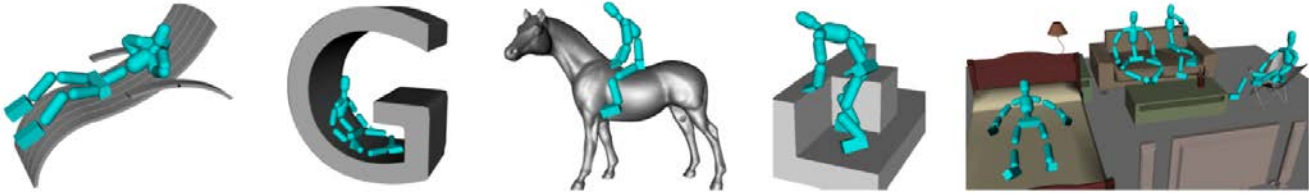


Figure 1. The proposed method can generate various contact-rich poses that are adaptive to the geometry of the environments.

1. Introduction

A virtual character that exhibits natural poses in relation to various items of furniture of arbitrary shape will give the impression of being able to perceive space. Recently, Liu et al. [2010] developed a physics-based animation technique that generates motions involving complex contacts with an environment, such as rolling. Lin et al. [2012] developed a novel framework using a sketching interface in which a user draws a target pose as a two-dimensional stick figure and determining a suitable three-dimensional pose with the genetic algorithm and gradient based optimization solver.

We develop a novel method that automatically finds various candidate poses suitable to the target environment and lets a user select the preferred pose. Given the user-specified location and direction, our method computes the potential support contacts for the character in the surrounding geometry of the environment and generates a set of stable poses that contact-rich and penetration-free. Our method allows for creating various contact poses including lying and standing poses.

2. Preprocessing – Collecting Support Triangles

A pose can be maintained if there exists a support triangle and no penetration exists between the pose and the environment. Candidate support triangles can be found solely from a pose. Therefore, we extract candidate support triangles from the pose database offline. We find the support triangles from all the triangles constructed by the three-combinations of a set of sample points that satisfy the equilibrium conditions (Fig. 2). Typically, a stable pose contains many support triangles, and a support triangle only needs to share the character's weight with a number of other triangles.

3. Online Pose Generation

When a user sets the desired position and direction for a character on the surface of the environment, our online algorithm creates suitable poses that are adaptive to the environment. We collect the

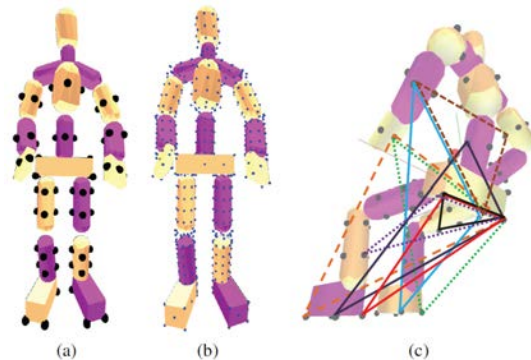


Figure 2. (a) Sample points on a character (b) Points for testing penetration (c) A subset of support triangles

admissible triangle clusters that contain valid support contacts for the target environment. The admissible triangle clusters are used to determine suitable pose clusters for a target environment. A pose cluster that is associated with at least one admissible triangle cluster is expected to find valid support contact in the target environment. We collect a set of admissible pose clusters that have valid support contacts are safe from penetration. All of admissible pose clusters can be considered to be valid for the target environment and it depends on the particular need as to which poses are selected. For each pose cluster selected by a user, we perform inverse kinematics to generate a pose for the target environment by minimizing the cost function.

4. Conclusion

We introduced a novel method to generate environment-adaptive character poses. We demonstrate the effectiveness of our method by creating contact poses for various items of furniture and synthetic environments (Fig. 1).

References

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SIGGRAPH 2014, August 10 – 14, 2014, Vancouver, British Columbia, Canada.

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ACM 978-1-4503-2958-3/14/08