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Sketch-Based Per-Frame Inverse Kinematics

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Abstract

We present a method that uses a sketch-based interface in conjunction with a parallelized per-frame inverse kinematics (Parallel-PFIK) method for the purpose of motion editing. The artist creates and edits 3D constraints through an intuitive and easy to use 2D interface. These constraints are passed to Parallel-PFIK in order to solve for the joint angles of the character in a fast and efficient manner. Parallel-PFIK employs multicore processors and current generation GPUs extending parallel damped least squares inverse kinematics to multiple frames in order to solve the entire animation in real time. Our method allows users to create and edit 3D animations using an intuitive 2D sketch-based interface bringing 2D artist into 3D character animation.

Categories and Subject Descriptors (according to ACM CCS): I.3.8 [Computer Graphics]: Three-Dimensional Graphics and Realism—Animation

1. Sketch-Based Constraints

With the advent of stylus-based 2D tablets, it has become increasingly more important to find intuitive methods for 3D character animation through 2D sketch-based interfaces [CBL*16, MHLB16]. Here we present a novel method for motion editing through joint trajectory creation and editing in combination with our Parallel-PFIK [HMLB16, LB04].

We edit trajectories (3D Cartesian points) of the articulated character and use them as constraints for our Parallel-PFIK. If the user is making a stroke in the vicinity of a initial trajectory, then we edit this trajectory. Otherwise we use the stroke drawn by the user and create a new trajectory. Similarly to previous work [CBL*16], for each stroke drawn by the artist, we first analyze the stroke and unproject rays into the fustrum of the scene. Then, depending on the camera look-at direction and the z-depth of the current trajectory, we compute a new 3D trajectory from the drawn 2D stroke. After substituting the part of the initial 3D trajectory with the new trajectory obtained from the 2D stroke, we fit a Kochanek-Bartels spline into this new trajectory. This spline then defines a set of constraints for the Parallel-PFIK which generates a new edited motion satisfying these constraints (see Fig. 1).

2. Per-Frame Inverse Kinematics

Our Parallel-PFIK uses a parallel tailored Per-Frame Inverse Kinematics method for solving the motion editing problem instead of using a general optimization formulation. We extends our GPU based DLS-IK algorithm, that is able to converge up to 150x faster as compared to a sequential state-of-the art implementation, to multiple frames. We initialize the DLS-IK algorithm on the GPU using a multicore processor. This provides a fast hybrid solution that utilizes the parallel computing resources efficiently, thus enabling 3D animation on a 2D sketch-based interface.

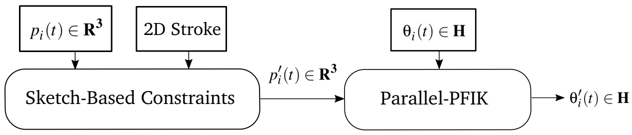

Figure 1: *Input $p_i(t)$ is the 3D Cartesian trajectory of the joint, whereas $\theta_i(t)$ is the input motion in posture space. The output is a new edited motion $\theta'_i(t)$ satisfying the constraints in $p'_i(t)$.*

References

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