Nutty Tracks - Symbolic Animation Pipeline for Expressive Robotics

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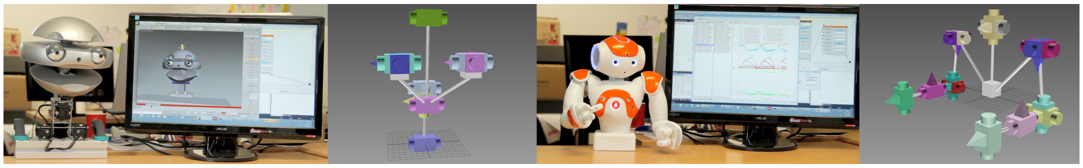

Figure 1: *Interaction between NuttyTracks, Autodesk® 3ds Max® and real robots.*

Abstract

NuttyTracks is a symbolic real-time animation system for animating any robotic character using animation tools commonly used by professional animators. Our system brings artists and programmers closer to each other in the quest for creating the illusion of life in robotic characters.

Keywords: animation, robotics, human-robot interaction

1 Introduction and Motivation

Robotic characters are becoming widespread as useful tools for both assistive and entertainment applications in the domain of human-robot interaction. Research on robot animation has therefore been struggling to overcome the physically limited expressivity that is inherent to a robotic embodiment. We have previously analysed how traditional principles of animation can be used in robot animation [Ribeiro and Paiva 2012]. However, current generic robot animation and interaction systems require deep mathematical and programming skills, which makes it difficult for artists to collaborate with programmers in order to achieve the illusion of life in robotic characters. This work provides an artist-oriented animation system that can work with any robotic embodiment.

2 Our Approach

Professional animators often use commercial software packages such as Autodesk® 3ds Max® software. We have developed an animation system called *Nutty Tracks* that can integrate with these software packages in interaction scenarios. Artists can therefore use their usual tools and software to design robot animation independently of its embodiment. The challenge of animating a robotic character with any kind of embodiment was overcome by developing a symbolic animation pipeline (Figure 2). The pipeline is composed by *Layers*, which are in turn composed of a sequence of *Animation Controllers* (AC). Each *AC* produces and outputs an *AnimationBuffer*. Each *Layer*'s *AC*s are traversed in a specific order. The output of one *AC* can be used as the input of the next one. The final *AnimationBuffer* computed in a *Layer* is then blended with those of the other *Layers*, thus producing a final *Animation Frame*.

The *AnimationBuffer* is composed of two fields. The *Meta-Data* contains frame information, and a reference to the *BodyModel* that the animation data corresponds to; The *Animation Data* is a list of pairs (Cn, V) where Cn is the name of a channel from the *BodyModel*, and V a value representing an angle or intensity. A *BodyModel* describes a robot body by listing its available channels, and their hierarchy. Each channel is associated to a unique name and a degree-of-freedom. After each iteration of the animation cycle, the computed AnimationBuffer is sent to the body, which can then interpret each channel, and act upon its physical motor controllers. The *BodyModel* is also used by the plug-in on the external animation software to generate a skeleton that artists can animate. In order to allow incremental animation without overflowing the robot with repeated data (causing unresponsiveness and jitter), each frame is filtered before being sent to the Body Interface, in order to remove channels containing data that does not significantly differ from the previous frame.

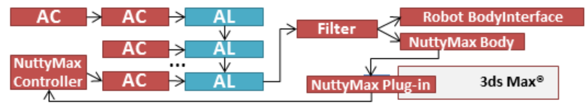

Figure 2: *Nutty Tracks integrated with Autodesk® 3ds Max® software through the NuttyMax plug-in. AL represents a generic Animation Layer, while AC represents a generic Animation Controller.*

By bringing animation to a symbolic level, we will be able to connect it with Artificial Intelligence systems. It will also allow us to procedurally generate and apply operators or filters on the animation curves in real-time, independently of the robot used. We are currently developing animation filters that can provide any robotic character with some of the principles of animation, such as *Slow In/Slow Out* or *Exaggeration* [Gielniak and Thomaz 2012]. We are also trying to understand to what extent and situations can animations be generically generated for any given robot. Finally, we will study how this system actually makes it easier for professional animators to work with robots on interactive animation scenarios, and how that reflects on the overall perception of lifelikeness.

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