Approaching real-time Character Animation in Virtual Productions

Jonas Trottnow, Simon Spielmann
http://research.animationsinstitut.de/
Filmakademie Baden Württemberg GmbH,
Animationsinstitut
David Moreno, Javi Agenjo
https://www.upf.edu/web/gti
Universitat Pompeu Fabra,
Interactive Technologies Group

Virtual productions get increasingly common in modern movie productions. The possibilities to visualize, edit and explore virtual 3D content directly on a movie set make it invaluable for VFX rich productions. Many of the virtual production scenarios also involve animated characters and motion capturing [4]. But the complexity of animations systems prohibits it's usage on a film set. Within the EU funded project SAUCE (Smart Assets for re-Use in Creative Environments) an extensive research on available virtual production tools and frameworks has been carried out. While most of them are not publicly available or open source, none of them had the possibility to interactively and intuitively animate characters on set.

SAUCE consists of 8 consortium partners including Filmakademie Baden-Württemberg (FA) and the Universitat Pompeu Fabra (UPF). Besides other topics, approaches are developed to make character animation and the involved characters themselves 'smarter'. This involves procedural character animation and machine learning being used to provide high level control over a character.

The R&D team of Filmakademie Baden-Württemberg developed the open source 'Virtual Production Editing Tools' (VPET) [3] over the last years. With as little hardware overhead as possible, VPET offers the possibility to stream an arbitrary 3D scene to tablet clients. On the tablets, the 3D scene can be aligned with the real world in augmented reality (AR) making the tablet a window to the provided set extension. Users can explore and edit 3D elements, lighting as well as rigid body animations. All clients and the scene host communicate changes among themselves through a synchronisation server, keeping the scene consistent.

To approach character animation in the virtual production toolset FA developed an open character streaming protocol for VPET. The entire character (including weights, skeleton etc.) can be transferred to the tablets at run time. The newly developed API then allows arbitrary external animation solving engines to animate the character through streamed bone animations. These animations are represented as a root bone translation and a new rotation for each bone. The updated pose is automatically synchronized and held consistent between participating tablet clients.

It does not make sense to author a complete animation from scratch with an on-set virtual production tool set, as it requires to much time and expertise to get a convincing result. Nevertheless providing the possibility to easily direct virtual characters on a film set is often desired. Tablets offer an intuitive way of interacting with elements during a virtual production e.g. in augmented reality (AR) being useful for directing characters. Flexibility and ease of use are the main targets for our work. Towards this goal, FA and UPF are working on a joint effort within the SAUCE project. On set, only high level commands can be used to drive a character. Commands like 'Go there', 'Run' etc. should be used on e.g. the VPET tablet tools. This requires that procedural animations are generated and that the character is animated in a scene aware manner. Obstacles should be avoided, uneven grounds need to be compensated etc. This technology is also known from game creation, but only slowly they are introduced into the film industry. Such complex, highly adaptable animation solving, required for virtual productions, cannot be executed on a tablet conveniently and with the required customisability.

UPF is working on a machine learning (ML) based human character animation engine. The ML network learns how humans move in different styles (e.g. running, walking, sad, happy...). Through the core technology, the learned animation can be applied to an arbitrary human character. This approach is thought for virtual characters which receive the orders directly from the artist. Furthermore, UPF is working on another approach, focused on automatically controlling the background characters, reducing the time spent if this task was done manually. UPF has developed a web tool in order to determine the characters' identity, including the behaviour and the style. This background character will be controlled by a graph programmed Hybrid Behaviour Tree, an evolution of common Behaviour Trees.

With this approach virtual characters are always aware of their surroundings to allow to the Hybrid Behaviour Tree system to compute the final action taking into account the characters properties and their environment. Additionally a character can interact with scene elements and extract relevant information from them. For example, a virtual character could go to a store and acquire some item needed to perform a concrete task, or react in real-time to changes on the scenario or its properties, adapting automatically the animations to that events. All this can be authored in a low-coding tool in a webbrowser as the engine is based on WebGL[1]. Through the introduced VPET animation streaming API, both approaches are easily integrated into the tablet tools and can even coexist within the same scene.

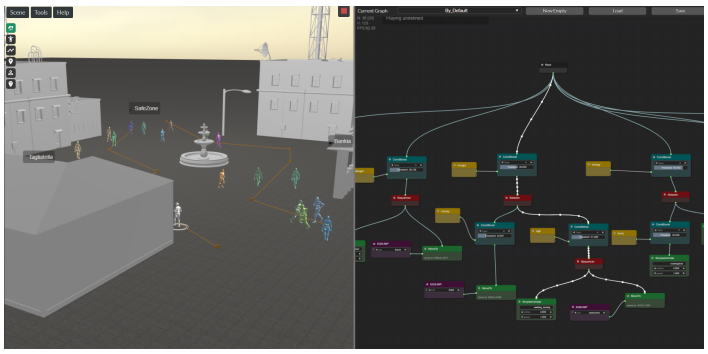

Figure 1: Interface of the web based Hybrid Behaviour Tree editor

FA provided the training data for the ML algorithm as high quality optical motion capturings. This database is also released publicly [2]. Additionally, FA is in charge of providing intuitive interfaces for character animations in VPET. Much like the animation of a rigid body, a walking path for the character will be definable by setting keyframes of an animation curve on the tablets. The resulting Bézier curve describes the path, a character should follow and can be consumed by the external animation solver for generating a convincing bone animation in real-time.

All in all the combination of a new character animation streaming API and two animation solving engines for different purposes form a good foundation for adding intuitive, high-level character animation to an on-set virtual production. In future, even more interaction possibilities will be added to the tablet clients as well as the animation solver. The tablet client could e.g. be extended to select different walking styles for a character and look-at positions could be defined as well.

In addition to the UPF and FA based character animation in virtual productions, the SAUCE project provides more character animation related research. The Trinity College Dublin, as example, is working on autonomous, real-time crowd simulations.

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