How to Support Collaborative Modelling with the emerging standard MPEG-4 MU

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Introduction

In a Collaborative modelling environment, multiple users may interact in a virtual environment to deform or modify shared 3D objects (e.g., for modelling and visualization of virtual prototypes). The challenges to collaborative modelling are related mainly to four aspects: user interaction with the virtual modelling environment, 3D objects concurrent editing, consistency maintenance among client terminals and real time rendering of the modified 3D objects.

The use of Non-Uniform Rational B-Splines (NURBS) surfaces accelerates the rendering process since a small number of control points are used to represent the objects, resulting in a large data compression. Nowadays a number of technologies has either emerged or evolved to support 3D environments, such as: X3D, Java3D and MPEG-4 MU. This poster shows how the emerging MPEG-4 MU standard can be used to support real-time modelling through NURBS in a shared virtual environment among multiple client terminals.

MPEG-4 MU support to consistency maintenance in a shared virtual environment

MPEG-4 is an ISO/IEC (ISO/IEC JTC1/SC29/WG11) standard, developed by the Moving Picture Experts Group (MPEG), for the codification and delivery of different media formats over a wide range of networks and computer plataforms. Part of the MPEG-4 standard defines a Binary Format Scene – BIFS, which codifies scenes in a compact and efficient way (10 to 15 times smaller than VRML files) [1].

The support to multiple users is under standardization, as an extension to the MPEG-4 standard (emerging MPEG-4 MultiUser). Consistency maintenance is obtained through a mechanism named Pilot/Drone and a BIFS-Command protocol, which are used to reflect objects state changes among all participants. It is also under development the Animation Framework eXtension (AFX), which defines a set of interoperable tools to support interactive animated content. AFX specifies new tools to accelerate scene rendering with better visual quality, such as geometry tools (NURBS surfaces and curves, subdivision surfaces etc), modelling tools (Nonlinear Global Deformation and Free-Form Deformations), among others [2].

The traffic generated by the BIFS Command Protocol for updating of NURBS objects

In a collaborative modelling environment where objects are modelled with NURBS surfaces and curves, the updating of the control points are fundamental, as they can be modified by one user and the result has to be propagated to the other client terminals.

The propagation of the updates is subject to delays due to messages transmission and processing. With the BIFS Command protocol, 164 bits are necessary to code the updating message of a NURBS object with one control point. (1 bit for the type of message, 1 bit for the command Id, 4 bits for zone Id, 4 bits for command category, 5 bits for the Node Id, 3 bits for the field Id, 2 bits for the modified position identification, 16 bits for specific identification and 128 bits for the new values of X, Y, Z with 32 bits for each coordinate and 32 bits more for the weight represented as W).

Considering the size of the updating message of a NURBS object with one control point, and the frequency with which this message can be transmitted in a collaborative modelling exercise, network traffic will not be a major obstacle for the immediate propagation of the scene modifications among the client terminals. The major delays will come from the exchange of information among client terminals and the MPEG-4 MU architecture components (MSC, MBK e MMH), besides message processing and scene updating at the remote client terminals. MPEG-4 MU emerging standard however, is a promissing technology for the support to collaborative modelling.

Bibliographic References
