Intelligraphics
Incorporated

Future SEDRIS Implications for X3D

Introduction

SEDRIS technologies have direct implications for the evolution of X3D towards supporting the representation of environmental data. These include the enhanced Geospatial component that supports the full capabilities of the SEDRIS Spatial Reference Model (ISO/IEC 18026) and a report that maps the usage of EDCS (ISO/IEC 18025) to X3D metadata nodes. While these are still under consideration, still to be analyzed is the SEDRIS Data Representation Model (DRM) (ISO/IEC 18023) that supports the organization and use of environmental data. This report suggests how the currently existing reports can be augmented and the missing analysis of the DRM can be created.

Enhanced Geospatial Component

In its current state, the enhanced Geospatial component augments the current X3D Geospatial component by supporting the specification of arbitrary SRFs in a manner that is fully backwards compatible with the current predefined SRFs. Still missing, however, is a better way of dealing with the limitations of the current single GeoOrigin. Therefore, the recommendation is that the Enhanced Geospatial Component be modified to either allow multiple GeoOrigin specifications or eliminate the need for specifying GeoOrigins altogether. In the former case, the specification would be modified to state exactly when, and under what conditions, a change of GeoOrigin can take place. In the latter case, the browser would be responsible for automatically adjusting the GeoOrigin to maintain adequate numerical precision.

The reason for needing a GeoOrigin in the first place is to take advantage of the increased numerical precision that exists in floating point number representations near the origin. This topic has been discussed already in the X3D Earth telecons and needs further discussion.

A solution to this problem is a necessary part of supporting a general purpose Geospatial component that is capable of representing a variety of scenarios such as touring the solar system (or the galaxy) in a space ship. In this example, several GeoOrigins may be needed:

1. While the spaceship is on a planet, an outside view of the spaceship would require a GeoOrigin for the local vicinity on the planet.

2. When the spaceship takes off, the GeoOrigin will have to transition to one appropriate for its position in space.

7644 Cortina Court
Carlsbad, CA 92009-8206
Phone: (760) 753-9027
FAX: (760) 753-9027

3. When the view is of the interior of the spaceship, a GeoOrigin based on the spaceship design is needed.

4. With each visit to a celestial body (i.e., planet, satellite, minor planet, or sun), a new GeoOrigin will be needed to maintain local numerical precision.

The single GeoOrigin currently supported is sufficient for maintaining accuracy within a single UTM zone. However, if other SRFs are used, numerical precision will seriously degrade with distance from the origin.

Commerical geospatial applications tend to hide the specification of a GeoOrigin from the users of those applications by automatically adjusting the GeoOrigin to maintain numerical precision. This is the ideal solution. However, when merging data from a variety of sources, it may be difficult to determine the most appropriate GeoOrigin. Since this is a key feature of X3D, further study of the problem is needed to see if it is reasonable to require a browser to do the necessary bookkeeping for optimizing numerical precision. If not, it will be necessary to design new functionality for X3D that makes it possible to provide multiple GeoOrigins each of which has a controlled scope.

EDCS Usage

The Environmental Data Coding Specification (EDCS) is an International Standard that provides a suitable means for standardizing the meaning of data. For example, a building can be described using geometry but geometry alone does not indicate what class (e.g., church, school, house, office building, embassy, etc.) of building the geometry represents. EDCS not only can classify the data, it can also standardize its properties and state and the units used to specify the properties.

The *EDCS Usage Report* already circulated considers the manner in which EDCS concepts can be mapped to X3D metadata nodes. It also suggests improvements to the X3D metadata facility to make this mapping more efficient. A different study by Travis Rauch (reported in his thesis *Savage Modeling Analysis Langauge (SMAL): Metadata for Tactical Simulations and X3D Visualizations*) describes the mapping of suitable metadata not to X3D nodes but to XML metadata tags. In addition, OGC standards for specifying geospatial properties should be considered so that direct support of OGC web services can be accessed. Altogether, a revised report of metadata specification for the X3D Earth project should be generated that combines the characteristics of these and other considerations.

Comparison of X3D and SEDRIS DRM facilities

The SEDRIS DRM is a general purpose method for representing environmental data. It has been successfully used in a variety of applications ranging from military training, military simulation, emergency preparedness planning, game playing, and many other usages. X3D also has a wide variety of applications but lacks some features that would facilitate its use as a means of presenting environmental data specified using the DRM.

This problem can be corrected by comparing the features of the DRM to those of X3D and specifying appropriate nodes for X3D that will facilitate the mapping from the DRM to X3D. For example, X3D has only a single, general LOD node and a special GeoLOD node. The single general node is based on distance from the viewer to a target. The level of detail is adjusted based as the viewer and object move in relation to each other. The GeoLOD node supports only two levels of detail (although these can be nested). Thus, the GeoLOD node supports a quadtree organization. On the other hand, the SEDRIS DRM supports four types of LOD in addition to one based on distance. The five SEDRIS DRM LOD representations are:

- Distance
- Map Scale
- Spatial Resolution
- Index
- Volume

Each has its particular usages. A study of these and the applicability of them to X3D is necessary to see if the additional types of LOD are necessary within X3D.

There are many features in the DRM that have no counterpart within X3D. A project that attempts to map the DRM features to X3D features would be helpful in filling in the gaps of X3D capabilities especially in support of the modeling and simulation community.

Summary

The following summarizes the recommendations of this report:

1. The enhanced Geospatial component should be augmented by text that describes how to maintain optimal numerical precision through either the use of multiple GeoOrigin specifications or by requiring the X3D browser to automatically optimize numerical precision when processing geospatial data.

2. Augmentations to the X3D metadata facility should be specified that increase the efficiency in which complex metadata can be represented.

3. A study should be undertaken that considers the capabilities of the SEDRIS DRM and makes recommendations on how to improve X3D to better support these facilities as necessary.