0 Introduction

0.1 Purpose

Spatial information processing requires a robust capability to describe geometric properties such as position, direction, orientation, and distance. Information is sometimes spatially referenced to local structures (Example: interior walls and doorways within a building) or local regions (Example: streets and buildings within a city), or to the Earth as a whole (Example: global weather). Information is sometimes spatially referenced to other celestial bodies (Examples: astronomical, orbital, and geomagnetic observations). Information is also sometimes spatially referenced to objects defined within contexts such as virtual realities (Example: 3D models). In each of these cases, a spatial reference frame is defined, with respect to which the values of geometric properties can be determined.

It is often necessary to represent a position in several different spatial reference frames, simultaneously, according to the context in which the position is to be used. Each spatial reference frame corresponds to a particular way of expressing position. Spatial reference frames are sometimes specified relative to moving objects (Examples: planets and spacecraft), and therefore provide spatial values that are a function of time. It is necessary to specify the time to which the spatial position refers, and the time for which the spatial reference frame is defined.

This document defines the conceptual model and the methodologies that allow the description, and transformation or conversion, of geometric properties within or among spatial reference frames. The Spatial Reference Model (SRM) supports unambiguous specification of the positions, directions, orientations, distances, and times associated with spatial information. It also defines algorithms for precise transformation of positions, directions, orientations, and distances among different spatial reference frames.

0.2 Design criteria

The concepts in this document were developed to fulfil the following requirements:

a) *Unification*: Define a comprehensive set of general principles and specific concepts that allow spatial information to be shared among different communities.

b) *Unambiguity*: Provide for the unambiguous specification of spatial concepts and the spatial relationships among geometric objects.

c) *Extensibility*: Provide a framework under which future spatial concepts can be accommodated through registration of new concepts.

d) *Completeness*: Specify a broad set of well-defined spatial reference frames, their parameter sets, and spatial operations.

e) *Implementability*: Define an application program interface supporting spatial reference frames and spatial operations.

f) *Mathematical formulation explicitness:* Provide mathematical formulations to support conformance testing.