Spatial Data Vision – Version, January 2025

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I. This document may be viewed by some as presumptuous. However, before declaring the following irrelevant, consider:

  A. This compilation is written to facilitate implementation of "best" practices for spatial data applications. The goal is to identify rigorous efficient computational tools for the end user.

  B. The digital revolution drives an abstraction which uses the underlying characteristics of 3D digital spatial data to identify the geometrical and stochastic relationships that contribute directly to benefits derived from their application, http://www.globalcogo.com/Part-I.pdf.

  C. Using the Earth-centered Earth-fixed (ECEF) geocentric coordinate system embraced by the scientific community, the global spatial data model (GSDM) is prefaced on a single origin for 3D spatial data. Computations in 3D space use rules of solid geometry and error propagation procedures - see http://www.globalcogo.com/gsdmdefn.pdf.

  D. Very broadly, efficient use of 3D digital spatial data involves:

    1. The technology and activities devoted to generating 3D spatial data.
    2. The activities and practices of those who use spatial data in myriad applications.

  C. Understandably, many are concerned with both categories. The specific point here is that the 3D GSDM provides an efficient interface between generating and using spatial data – see Diagram 1.1 and Table 1.2 in "3D Imaging of the Environment: Mapping and Monitoring," Edited by John Meneely – http://www.tru3d.xyz/common.pdf.

  Whether exporting, archiving, or using spatial data, the GSDM provides a common definition and format for location (geocentric X/Y/Z) and accuracy attributes (covariance matrix data are optional). With a common format in place, generators can concentrate on measurements etc. and users can concentrate on applications. Whether operating in either or both categories, users can benefit from the commonality provided by a rigorous well-defined spatial data model.

  D. Two issues related to using a single origin for 3D digital spatial data are:

    1. Traditional practice relies on separate horizontal and vertical datums having disparate origins. The GSDM defines an integrated 3D datum based on Earth's center of mass.
    2. Computations based on disparate origins lead to use of pseudo 3D while rules of solid geometry referenced to a single origin are the basis of true 3D computations.

  E. Commentary/observation: Geodesy equations referenced to the mathematical ellipsoid and map projection equations based on latitude and longitude have been developed and programmed for efficient computation. That geometry is well in hand and understood by many. However, the GSDM solid geometry equations for performing computations in 3D space are considerably less complicated and more readily understood by many users. It not to be said that geodesy equations are "better" or that GSDM equations are "inferior." No rigor is sacrificed by using the GSDM. But an observation is that error propagation computations based on the GSDM are considerably less onerous than achieving the same results using traditional equations.

II. Current items relevant to a discussion of implementing the GSDM for routine use of 3D digital spatial data include:

A. Part I: 3D Digital Spatial Data – Time is 4th Dimension. Line 4 of link posted at www.tru3d.xyz.

B. Part II: Benefits of a Standard and examples of standards development, Link above.

C. Part III: Challenges & Opportunities Using 3D Digital Spatial Data. In draft form, Ditto.

D. Bill Hazelton wrote two excellent articles on the Surveying Revolution. Public links are:
https://geosages.org/pdfs/Conf_2015/Paper_Hazelton_Revolution_1.pdf
https://geosages.org/pdfs/Conf_2015/Paper_Hazelton_Revolution_2.pdf

E. Hazelton's articles are formally published in Surveying & Land Information Science (SaLIS), Part I, Vol. 72, No.3, and Part II, Vol 83. No. 2. There are minor differences, public/published.

F. In a recent email, Hazelton quotes Peter Medawar (1960 Noble Laureate in Medicine and Psychology) as saying that as a science matures, over-reaching concepts greatly simplify issues.

G. "The Structure of Scientific Revolutions" 3rd Ed., 1996, T. Kuhn – widely regarded by many.

H. "The Innovator's Dilemma: When new technologies cause great firms to fail," C. Christensen.

I. "Spatial & Temporal Reasoning in Geographic Information Systems," Egenhofer/Colledge.

J. Spatial Data Accuracy material challenged/refuted, www.globalcogo.com/validation.pdf.

K. Editorial: "150 Years of Surveying Engineering" Journal of Survey Engineering, November 2024.

L. ASCE/UESI committees (38 & 75) work on standards for underground utilities, January 2025.
(contact: Thersa Metcalfe, ASCE - Director of Standards, tmetcalfe@asce.org)

M. TRB webinar to resolve ambiguities between virtual 3D and the real world – December 18, 2024.
(contact: Andie Pitchford, Distance Learning Coordinator – TRB, APitchford@nas.edu)

N. NGS funding to address "Crisis in Geodesy,"
(See - https://geodesy.noaa.gov/grant-opportunities/fy23-awards.shtml)

O. Mike Olsen's Jan. 2025 presentation to AAGS membership, "Roadmap to Future of Surveying."
(See - https://oregonstate.app.box.com/s/y6fwwuz1y3njub0yo2bpa4k2h0m6e7k1)

P. Example of SpaceX returning rocket booster to launch pad – see www.tru3d.xyz/catch.pdf.

Q. Definition of "common data exchange" for spatial data - http://www.tru3d.xyz/common.pdf.

R. Spatial Data Vision – needed to justify activities in Part II.