Understanding and Modelling Spatial Change

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Introduction

- GIS uses multiple static databases
- Spatial change is intrinsically associated with time
- Development of Unified Spatio-Temporal framework
- Relate Time explicitly to Space

Introduction

- Important aspects associated with spatio-temporal change
- Different application areas – different demands on temporal GIS
- Differences are a result of :
  - Way the objects are formed
  - Spatial reasoning required

Example

- “Planning” – a very important application, is a temporal effort

- Three cases for Spatio-Temporal Modelling:
  - Spatial change in cadastre
  - Spatial change in created socio-economic units
  - Building temporal GIS to record uncertain information

Space, Time and Place

- Human experience – Visualization
- Every activity generates a particular spatio-temporal structure
- Time and Space intertwine and define each other
- Place - a static concept

Spatial Planning

- Time and Space – To set goals
- Goal has temporal and spatial meaning
- Traditional GIS – too simplistic
- Current GIS are inadequate to support planning, due to lack of concrete theoretical foundation

Time and change in Geography

- Space, relations in space and changes in space
- Static sets of data does not serve the goals
- Should also deal with definite and indefinite, finite and infinite temporal information

Diagrammatic conceptualization

- Geographic space-time matrix – Early model incorporating temporal information in geography
  - Columns – places
  - Rows – characteristics
  - Intersection – cell containing geographic fact
  - Spatial changes over time – cross sections from every time instance of interest

Diagrammatic conceptualization

- Comparable conceptualization by Dangermond in 1984
  - Time – one of the three main constituents of GIS
- Recent developments to tackle issue of time
  - Absolute or relative time
  - Point or interval time
  - Valid or transaction time
  - Quantitative and qualitative temporal reasoning

Spatio-temporal Modelling

- A successful and unified approach
  - Conceptual problems to solve prior to implementation issues
- Space and time should be considered conceptually equivalent – Modelling point of view

A conceptual taxonomy of spatio-temporal characteristics

- Changes affect any phenomenon attributed to space
- Spatio-temporal characteristics of a phenomenon is classified as 5 components:
  - Internal characteristics
  - External characteristics
  - Temporal characteristics
  - Behavioral-Methodological characteristics
  - Quality characteristics (meta properties)

Components of Conceptual taxonomy

- Internal characteristics
  - Static properties (shape, orientation etc.,)
  - Motion properties
- External characteristics
  - Location (absolute or relative)
  - Dynamic topology
  - Non-geometric relations-dependencies
- Temporal characteristics
  - Life duration
  - Temporal order
  - Created by & transformed into

Components of Conceptual taxonomy

- Behavioral – methodological characteristics
  - Resistance to changes
  - Rules applicable
- Quality characteristics
  - Degree of detail
  - Relative importance
  - Certainty-reliability

Change and its effects

- All the characteristics of the taxonomy are subject to “change”
- Change itself is expressed by characteristics of the other components
- The interrelations between the characteristics are absent in current GIS
- A potential area for research

Temporal resolution and Spatial resolution

- Can be related in two ways
  - Using a phenomenon based description as reference to spatial and temporal attributes
    - Vector approach
  - Using a space-time discretion as reference, with description of states of phenomena
    - Raster approach

Applications demanding spatio-temporal modelling

- Three categories
  - Changes in widely known and well established bounded SEUs created by cadastre
  - Other SEUs whose spatial definitions varies a lot
  - Applications exhibiting difficulty of formalizing uncertain spatio-temporal information.

Spatio-temporal structures about history

- Selection of efficient spatio-temporal structures
- Formalization of historical knowledge
- Knowledge about space and time is mostly relative and rarely absolute

Summary

- Unified spatio-temporal framework
- Application induced classification of spatio-temporal characteristics affected by change
- Different applications make different demands on temporal GIS

Thanks !!!!

Queries ????