Geog183: Cartographic Design and Geovisualization Spring Quarter 2020

Lecture 13: Map animation
Static ways of showing change
Showing ONLY change

From

To

Temporal Resolution/Granularity
Animation

• Rare in cartography prior to the Internet
• First case probably Disney WW2
• Thrower 1959 *Animated Cartography*
• Tobler’s Detroit movie 1970
• Dutton’s animated hologram 1979
• LA the Movie (1987) [https://www.youtube.com/watch?v=6RsXCbpJG54](https://www.youtube.com/watch?v=6RsXCbpJG54)
• Peterson *Interactive and Animated Cartography* 1995
• By 1999 become *Multimedia Cartography*
• Animation really begins with Web Cartography
Victory through Air Power (1942) Disney
Victory Through Air Power


- Start at 36:20

- Projections
- Animated line symbols
- Flow maps
- Trajectories
- Spreading polygons
- Animated icons/3D models
Tobler 1970

- Created fishnet perspective views of population density from census
- Shot frame-by-frame with lag onto film

A COMPUTER MOVIE SIMULATING URBAN GROWTH IN THE DETROIT REGION

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University of Michigan

In one classification of models [16] the simulation to be described would be considered a demographic model whose primary objectives are instructional. The model developed here may be used for forecasting, but was not constructed for this specific purpose, and it is a demographic model since it describes only population growth, with particular emphasis on the geographical distribution of this growth.

As a premise, I make the assumption that everything is related to everything else. Superficially considered this would
Tweening One frame/month at 16 fps using numerical approximation

https://www.youtube.com/watch?v=kRsF9S8JqBI

The first (and perhaps only) animated thematic map to be produced as an integral hologram

Rotating celluloid cylinder within which a 3D demographic map of the United States hovers

US Census counts of population by county from 1790 to 1970 were uniformly interpolated to an equal-area grid and displayed as statistical surfaces

Interpolated to one-year intervals, yielding 181 maps

Filmed in sequence along with titles and the 16-mm animation

Transferred in three batches to integral holograms, which are wrapped around a plexiglass cylinder 18 inches across

A clear light bulb below the cylinder provides illumination for reconstructing the images, which rotate and change in time as the display revolves

Produced for the 1979 Harvard Computer Graphics Week Conference

Displayed at The Computer Museum in Boston, Place Pompidou in Paris and on public television
American Graph Fleeting (http://youtu.be/tl160bBcmbA)
Two models for animation

• Frame by frame
  • Related to small multiples
  • Frame rate important
  • Tweening by interpolation

• By model
  • Tweening by modeling
  • 2D and 3D, makes it 4D
  • Needs full descriptive geometry and object specification
  • Movement by trajectory
https://www.census.gov/dataviz/visualizations/050/
Frame animation

Made with Inkscape and Makeagif.com
Models and motion
New visual variables

• DiBiase et al. (1991): duration, rate of change and order
• Duration is the unit of time a frame or scene is displayed, affecting the smoothness of the animation. The shorter a frame is displayed, the smoother the animation will appear
• Smoothness of animation is also a function of the rate of change
• Order refers to the time sequence in which animation is played out, usually presented in chronological
• MacEachren (1995) added display date (time at which change is initiated), frequency (number of times identifiable forms are displayed) and synchronization (correspondence of 2 or more time series)
Viewpoint and figure

- Static 2D map with time as sequence
- Moving focus with trace
  - https://www.youtube.com/watch?v=x67WP7IayJY
- Moving viewpoint
- Moving viewpoint and image
- Zoom and pan
- Full interaction (e.g. X3D, GeoVRML)
Moving focus and trace
Aftereffects
Tripline

Raiders of the Lost Ark (1981)

https://www.youtube.com/watch?v=5TY5Fp6O5iM
Types of animation

• Temporal Animation: needs legend
• Non-Temporal Animation: shows changes against some other variables other than time. The variable might be place, position, generalization level etc.
• Non-temporal animation types
  1. Fly through/fly over (e.g. Google Earth tour)  
     https://www.youtube.com/watch?v=OlboVgGdj8cA&index=10&list=PLSflflfMDqwu5KhTQjHN3g9u8Xg0Wds1
  2. Cartographic zoom
  3. Classification animation
  4. Generalization animation
Historical growth of Santa Barbara:
Tweening using SLEUTH model
gifmerge, GIFmaker.me, GIMP with animation plug-in
Douglas-Peucker for Michigan Counties

Example (Using Animation) Courtesy of Brad Allen and Waldo Tobler.
Sweep by attribute

Female Percentage of Elected Local Officials, 1987

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Interactive animation control (weather.com)
Visualization of Uncertainty

Prof. Dr. Bernd Fröhlich
Visualization of Uncertainty: Visualizing Errors and Uncertainties in Geo-Scientific Data
http://www.uni-weimar.de/cms/medien/vr/research/visualization/scivis/uncvis.html
Lobben 2008
Donohue, Sack, Roth 2013 Cartographic Perspectives
Time series with Leaflet and Java by slider
<table>
<thead>
<tr>
<th></th>
<th>Existence</th>
<th>Spatial location</th>
<th>Shape and size</th>
<th>Thematic data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instant events</td>
<td>What events occurred and where?</td>
<td>Where each object was at t?</td>
<td>What shapes/sizes had the objects at t?</td>
<td>What were values of an attribute at t? How were they spatially distributed?</td>
</tr>
<tr>
<td>Durable objects</td>
<td>What objects existed and where?</td>
<td></td>
<td></td>
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<td>Single moment t</td>
<td></td>
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</tr>
<tr>
<td>Two moments t1 and t2</td>
<td>What is the difference in number, kind, or spatial distribution of events between t1 and t2?</td>
<td>What objects remained, appeared, or died? How did the spatial distribution change?</td>
<td>Where/how far did each object move?</td>
<td>What is the difference between shapes/sizes at t1 and t2?</td>
</tr>
<tr>
<td>Interval [t1, t2]</td>
<td>What events occurred during [t1, t2]?</td>
<td>What objects existed, appeared, or died during [t1, t2]?</td>
<td>How did the objects move? (trajectory)</td>
<td>What is the difference between values/spatial variations of the attribute at t1 and t2?</td>
</tr>
<tr>
<td>(summary)</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Interval [t1, t2]</td>
<td>How did the number, kind, spatial distribution pattern of events/objects change in time?</td>
<td>How fast did the objects move? Did they meet? How did the speed change?</td>
<td>How did the shapes/sizes develop with the time?</td>
<td>How did the values and their spatial distribution develop in time?</td>
</tr>
<tr>
<td>(progress)</td>
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</table>

Table 1. Classification of analysis tasks emerging in the course of exploration of spatio-temporal data
Animation examples

• World history https://vimeo.com/88625055
• Battle of the Wilderness https://www.youtube.com/watch?v=YsGiz6M5iFc
• Flight Aware Real time air traffic http://flightaware.com/live/
• Real time Marine traffic http://www.marinetrack.com/
Motion capture
Lidar movie set capture
Green screen  (greenscreenstudio.multimediamktg.com)
Summary

• Map animation has a history dating to the 1940s, and perhaps earlier
• Early work was tied to film-making
• Web and internet made animation simpler
• Many mapping tools now support animation
• Animation involves additional visual variables, movement cognition
• Types listed by multiple scholars, no agreement as yet
• Lots of great examples on the web, often linked to user interaction
• New tools emerging from the digital movie industry