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TIN-based Tag Map Layout

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Abstract

With the widespread use of tag clouds, multiple map-based variations have been proposed. Like standard tag clouds (also called word clouds), these 'tag maps' all share the basic strategy of displaying words within a 'geographic space' and scaling the word size to depict frequency (or importance) of those words within some dataset. While some tag maps simply plot a standard tag cloud on top of a map, the subset of tag maps we focus on here are those in which the collection of words are displayed within bounded geographic regions (often of irregular shape) that the words are relevant for. For this form of tag map, map scale and polygon shape add constraints to word size and position that have not been considered in most prior approaches to tag map word layout. In this paper, we present a layout strategy for tag map generation that includes consideration of the shape and size of the geographical regions acting as containers for the tags. The method introduced here uses a triangulated irregular network (TIN) to subdivide the geographical region into many triangle subareas, with the centroid of each triangle being a potential location to centre a tag on. All the triangles are sorted by their area and all the tags are sorted by their weight value (e.g. frequency, importance or popularity). Positioning of tags is undertaken sequentially from most important (or frequent or popular) with potential locations being the TIN triangle centroids (tried from largest to smallest triangle). After each tag placement, the TIN is recalculated to integrate the tag centroid and bounding corners into the TIN creation. The limited whitespace in the geographical region, at any specific scale, is used fully by dynamically adjusting the font size along with the number and the direction of tags. The method can be applied to add tags within geographic polygons that are convex, concave and other more complex regions containing holes or islands.

Cartographic Symbol Design Considerations for the Space–Time Cube

Christopher League & Patrick Kennelly

Abstract

The cartographic representation of geographic phenomena in the space–time cube comes with special challenges and opportunities when compared with two-dimensional maps. While the added dimension allows the display of attributes that vary with time, it is difficult to display rapidly varying temporal data given the limited display height. In this study, we adapt 2D cyclic point symbols to construct 3D surfaces designed along a helical path for the space–time cube. We demonstrate how these complex 3D helical surfaces can display detailed data, including data reported daily over 100 years and data reported in four-hour intervals over a year. To create the point symbols, each value is plotted along the curve of a helix, with each turn of the helix representing one year or week, respectively. The model is modified by varying the radii from the time axis to all points using the attribute value, in these cases maximum daily temperature and four-hourly ridership, and then creating a triangulated surface from the resulting points. Using techniques common to terrain representation, we apply hue and saturation to the surface based on attribute values, and lightness based on relief shading. Multiple surfaces can be displayed in a space–time cube with a consistent time interval facing the viewer, and the surfaces or viewer perspective can be rotated to display synchronized variations. We see this method as one example of how cartographic design can refine or enhance operations in the space–time cube.

Cartograms for Use in Forecasting Weather-Driven Natural Hazards P. 134-145

Florian Pappenberger, Hannah L. Cloke & Calum A. Baugh

Abstract

This paper evaluates the potential of using cartograms for visualizing and interpreting forecasts of weather-driven natural hazards in the context of global weather forecasting and early warning systems. The use of cartograms is intended to supplement traditional cartographic representations of the hazards in order to highlight the severity of an upcoming event. Cartogrammetric transformations are applied to forecasts of floods, heatwaves, windstorms and snowstorms taken from the European Centre for Medium-range Weather Forecasts (ECMWF) forecast archive. Key cartogram design principles in standard weather forecast visualization are tested. Optimal cartogram transformation is found to be dependent on geographical features (such as coastlines) and forecast features (such as snowstorm intensity). For highly spatially autocorrelated weather variables used in analysing several upcoming natural hazards such as 2m temperature anomaly, the visualization of the distortion provides a promising addition to standard forecast visualizations for highlighting upcoming weather-driven natural hazards.

Effectiveness of Dynamic Point Symbols in Quantitative Mapping P. 146-160

Paweł Cybulski & Łukasz Wielebski

Abstract

The main focus of this paper is the effectiveness of dynamic point symbols in the presentation of quantitative data. Such symbols are of particular use in the design of animated maps and computer games. The authors examine three existing techniques of using dynamic point symbols to present quantitative data: blinking, pulsation, and rotation. The aim of the study is to compare their effectiveness with that of classical cartographic animation techniques. The results of the study show that in animated map design, dynamic point symbols might be used to present not only qualitative but also quantitative data with comparable effectiveness. The results may serve as the basis for designing dynamic point symbols to be as effective as the classical techniques used in animated cartography.

An Artificial Bee Colony-based Algorithm to Automatically Create Colour Schemes for Geovisualizations P. 161-174

Mingguang Wu, Taisheng Chen, Hong Wang, Guonian Lv, Huien Li, Zhao Jin & Yi Tao

Abstract

Creating appropriate colour schemes is challenging for both novice and experienced cartographers. This paper introduces an artificial bee colony (ABC) algorithm to automatically create various colour schemes. Colour scheme creation is treated as a constrained search problem in a continuous colour space. We considered the gamut of the target device and a series of cartographic rules, such as convention, discrimination, contrast, perceptual uniformity and brightness mirror, in the ABC algorithm and presented detailed initialization, fitness definition, local exploration, and global exploration methods for creating qualitative, sequential and diverging colour schemes. The proposed method is evaluated with a case study, and the results indicate that compared with the brute force search method, the proposed method can create satisfying colour schemes of similar quality but significantly improved efficiency.

The Impact of Global/Local Bias on Task-Solving in Map-Related Tasks Employing Extrinsic and Intrinsic Visualization of Risk Uncertainty Maps P. 175-191

Čeněk Šašinka, Zdeněk Stachoň, Petr Kubíček, Sascha Tamm, Aleš Matas & Markéta Kukaňová

Abstract

The form of visual representation affects both the way in which the visual representation is processed and the

effectiveness of this processing. Different forms of visual representation may require the employment of different cognitive strategies in order to solve a particular task; at the same time, the different representations vary as to the extent to which they correspond with an individual's preferred cognitive style. The present study employed a Navon-type task to learn about the occurrence of global/local bias. The research was based on close interdisciplinary cooperation between the domains of both psychology and cartography. Several different types of tasks were made involving avalanche hazard maps with intrinsic/extrinsic visual representations, each of them employing different types of graphic variables representing the level of avalanche hazard and avalanche hazard uncertainty. The research sample consisted of two groups of participants, each of which was provided with a different form of visual representation of identical geographical data, such that the representations could be regarded as 'informationally equivalent'. The first phase of the research consisted of two correlation studies, the first involving subjects with a high degree of map literacy (students of cartography) (intrinsic method: $N = 35$; extrinsic method: $N = 37$). The second study was performed after the results of the first study were analyzed. The second group of participants consisted of subjects with a low expected degree of map literacy (students of psychology; intrinsic method: $N = 35$; extrinsic method: $N = 27$).The first study revealed a statistically significant moderate correlation between the students' response times in extrinsic visualization tasks and their response times in a global subtest ($r = 0.384$, $p < 0.05$); likewise, a statistically significant moderate correlation was found between the students' response times in intrinsic visualization tasks and their response times in the local subtest ($r = 0.387$, $p < 0.05$). At the same time, no correlation was found between the students' performance in the local subtest and their performance in extrinsic visualization tasks, or between their scores in the global subtest and their performance in intrinsic visualization tasks. The second correlation study did not confirm the results of the first correlation study (intrinsic visualization/'small figures test': $r = 0.221$; extrinsic visualization/'large figures test': $r = 0.135$). The first phase of the research, where the data was subjected to statistical analysis, was followed by a comparative eye-tracking study, whose aim was to provide more detailed insight into the cognitive strategies employed when solving map-related tasks. More specifically, the eye-tracking study was expected to be able to detect possible differences between the cognitive patterns employed when solving extrinsic- as opposed to intrinsic visualization tasks. The results of an exploratory eye-tracking data analysis support the hypothesis of different strategies of visual information processing being used in reaction to different types of visualization.