Visual Analytics Towards Big Data

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January 16, 2018

Overview

1. Information Visualization
   - Introduction of Information Visualization
   - Specific methods and techniques
2. Human-computer Interaction
   - Introduction of Human-computer Interaction
   - Topics in HCI
3. Visual Analytics
   - Introduction of Visual Analytics
   - Implement of Visual Analytics

Introduction of Information Visualization

Information visualization or information visualisation is the study of (interactive) visual representations of abstract data to reinforce human cognition. The abstract data include both numerical and non-numerical data, such as text and geographic information.

- visual representations of abstract data
- different from scientific visualization
- emergence from research in human-computer interaction, computer science, graphics, visual design, psychology, and business methods

Specific methods and techniques

- Cartogram
- Cladogram (phylogeny)
- Concept Mapping
- Dendrogram (classification)
- Information visualization reference model
- Graph drawing
- Heatmap
- HyperbolicTree
- Multidimensional scaling
- Parallel coordinates
- Problem solving environment
- Treemapping

Heatmap

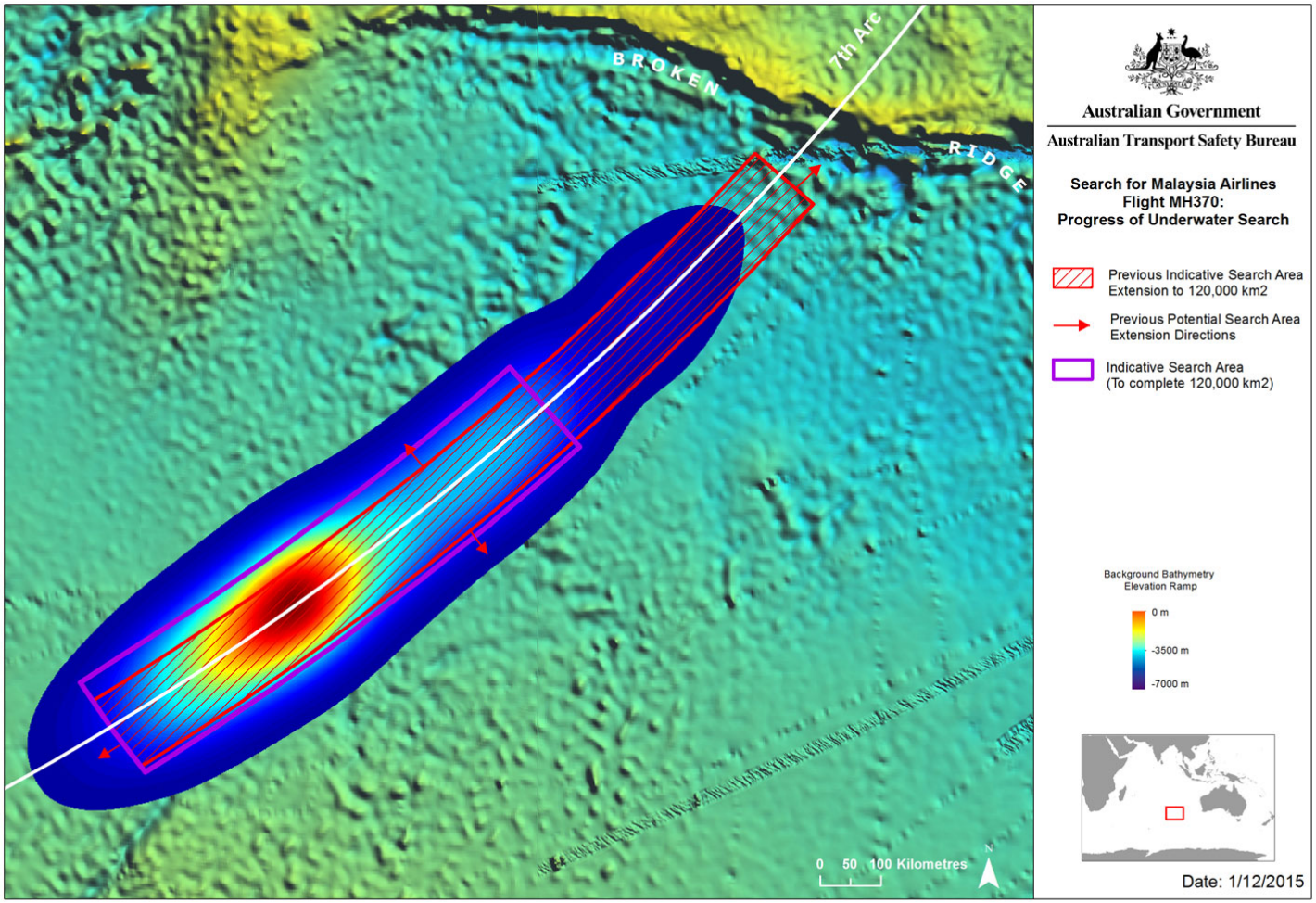


Figure 1: MH370 location probability heat map

Heatmap - color schemes

Rainbow colormaps are often used, as humans can perceive more shades of color than they can of gray. However, this is discouraged by many in the scientific community, for the following reasons: [1]

- The colors lack the natural perceptual [2]
- Common colormaps have uncontrolled changes [3]
- Not actually present [4]

[1] Borland; Russell (2007). "Rainbow Color Map (Still) Considered Harmful". IEEE Computer Graphics and Applications.

[2] How NOT to Lie with Visualization – Bernice E. Rogowitz and Lloyd A. Treinish – IBM Thomas J. Watson Research Center.

[3] Harrower, Mark; Brewer, Cynthia A. (2003). "ColorBrewer.org: An Online Tool for Selecting Colour Schemes for Maps".

[4] Green, D. A. (2011). "A colour scheme for the display of astronomical intensity images".

Multidimensional scaling

Multidimensional scaling (MDS) is a means of visualizing the level of similarity of individual cases of a dataset. It refers to a set of related ordination techniques used in information visualization, in particular to display the information contained in a distance matrix. It is a form of non-linear dimensionality reduction.

General forms of loss functions called Stress in distance MDS and Strain in classical MDS. The strain is given by: [5]

$$\min_{x_1,x_2\ldots x_n} \left(\sum_{i<j} (\|x_i - x_j\| - d_{ij})^2 \right)^{\frac{1}{2}} \tag{1}$$

[5] Borg,, I.; Groenen, P. (2005). Modern Multidimensional Scaling: theory and applications (2nd ed.).

Introduction of Human-computer Interaction

Human–computer interaction (commonly referred to as HCI) researches the design and use of computer technology, focused on the interfaces between people (users) and computers.

Much of the research in the field of human-computer interaction takes an interest in:

- Methods for optimizing a design for a desired property.
- Methods for evaluating and comparing interfaces.
- Methods for studying human computer use more broadly.
- Conceptual frameworks for the design of computer interfaces.
- Perspectives that critically reflect upon the values.

Topics in HCI

- User customization.
- Embedded computation.
- Augmented reality.
- Knowledge-driven human-computer interaction.

Augmented reality

AR - Augmented Reality

Figure 2: AR - Augmented Reality

Augmented reality

VR - Virtual Reality

Figure 3: VR - Virtual Reality

Augmented reality

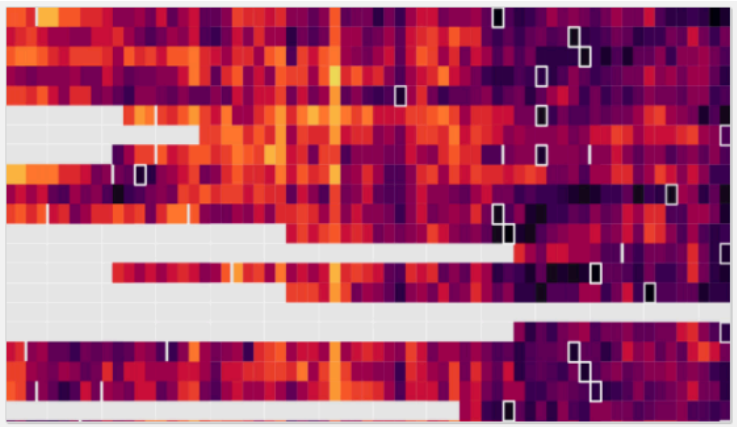
HUD - Head Up Display

Figure 4: HUD - Head Up Display

Introduction of Visual Analytics

Visual analytics is an outgrowth of the fields of information visualization and scientific visualization that focuses on analytical reasoning facilitated by interactive visual interfaces. Visual analytics integrates new computational and theory-based tools with innovative interactive techniques and visual representations to enable human-information discourse.

Tableau



Visual History of the MLB

Using data from Lahman Baseball Database, Jacob Olsufka creates a visual history of the MLB.

January 12, 2018

Cross-border Ecommerce in Europe

The Centre for Market Insights shares the results of a research project about the state of cross-border ecommerce in 31 European countries.

January 11, 2018

Figure 5: Tableau : https://public.tableau.com/zh-cn/s/gallery

Matlab

Figure 6: Matlab : https://cn.mathworks.com/