Focus + Context + Orientation with the Phaser Tool

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ABSTRACT
Most hierarchical information systems (Yahoo, the Online Directory) present the organization of these high dimensional spaces as fixed hierarchies. Information visualization browsers like the Hyperbolic Browser allow a user to pan and zoom into a hierarchical information space while supporting both Focus+Context exploration of the space. Nonetheless, Focus+Context work supports exploration of only a single, fixed orientation of the hierarchy. We wish to extend Focus+Context to include Orientation. To that end, we present Phaser, a UI tool that adds orientation to Focus+Context to allow users to determine not only where they will focus in an information space, but how the relations in the space will be organized as most appropriate for their interests.

KEYWORDS: n-dimensions, manipulation, interaction, gui, information, visualization.

INTRODUCTION AND RELATED WORK
The goal of Focus+Context interaction designs [4] is to help users maintain a general context for information while they focus on a more particular part of an information space. The Hyperbolic Browser [3], as well as tools such as Pad++ [1], or visualizations like physical Focus+Context combined displays [2]] support general context for user-determined specific focus. While these tools let users determine focus within the fixed organization of a data set, such as focusing on elements of a large tree, these tools do not generally let the user manipulate the data set itself, as part of determining either a better context or focus for the user.

For instance, suppose a user is presented with a tree (perhaps in a Hyperbolic Browser) representing classical music, where the tree is organized first by Period, then by Composer, then by Arrangement. Using Focus+Context tools across a visualization of this space, the user might pan to the Romantic period, zoom into the composer Beethoven, pan over to Symphony and, zooming in, see 9 symphonies. But what if the user would rather focus on Symphonies in general, rather than simply Beethoven's

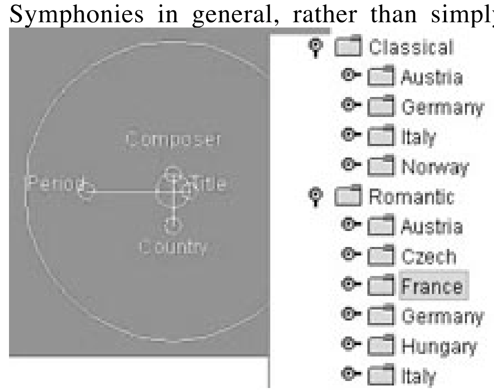

Figure 1. Phaser tool operating on a List hierarchy, privileging Period then Country.

symphonies? With a fixed information hierarchy, the users' focus is constrained. In this case, that means they would not be able to *orient* the data to privilege the Arrangement dimension before Period or Composer; they would not see just from the arrangement of the data, for instance, that Symphonies do not exist until after the Early Music Period.

To support Orientation as a part of user-determined focus in information exploration, we developed the Phaser tool. With the tool, we can suppor user-determined organizations of high dimensional spaces like Classical Music. We define an n-cube projected on a plane. The user can rotate the cube to privilege a particular dimension. The rotation in turn reorganizes the information hierarchies: Period Composer Arrangement or Period Composer. In the following sections we present the design and implementation of this orientation extension to Focus + Context.

DESIGN
Our tool must be able to handle the manipulation of hierarchies defined from high dimensional information spaces. We also wish to have a flexible output regardless of its physical meaning. We therefore use a non-orthogonal n-

dimensional coordinate system. Any phase – module pair in the 2D plane would correspond to at least one axis's real position in the n-dimensional space. We note that the Phaser tool deals only with the projection, not what is actually generating the projection.

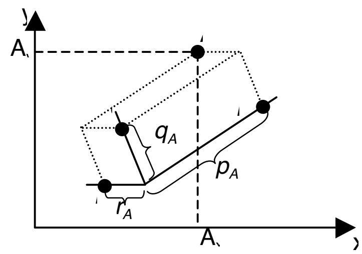

Figure 2 – A point 'A' and its coordinates in the coordinated axis '*p*', '*q*' and '*r*'.

Assuming that a non-orthogonal n-dimensional system is formed by line segments (axis) connected by their vertices in a common origin, this system can be projected in a two dimensional projection plane and generically represented by the diagram in Figure 2. Each point in this system has a coordinate (value) for each attribute (axis), its coordinates in the x – y projection plane are and each projection forms orbits around points in a projected hierarchy:

$$x = k \cdot \sum_{i=0}^{n} Module_i \cdot \cos\left(Phase_i + 2\pi \cdot Value_i\right)$$

$$y = k \cdot \sum_{i=0}^{n} Module_i \cdot \sin\left(Phase_i + 2\pi \cdot Value_i\right)$$

Here, $\boldsymbol{x}$ and $\boldsymbol{y}$ are the coordinated axis in the projection plan, $\boldsymbol{Value_i}$ is the value of the point with respect to attribute *I*, $\boldsymbol{Module_i}$ is the module of the projected attribute *i* normalised [0, 1] in the x – y plan, set on the Phaser tool by the user, $\boldsymbol{Phase_i}$ is the phase α of the projected attribute *i* in the x – y plan, $\boldsymbol{n}$ is the number of attributes and $\boldsymbol{k}$ is a convenient arbitrary constant for screen positioning. The phase a of the projected attribute *i* in the x – y plane is added to the value of the point with respect to attribute *i*, which is constrained in the interval [0, 1], given the axis projections are normalized, becoming a contribution value in the interval [0, 2p]. As a result, the projection phase controls the phase in the x – y plane and the projection module controls the "orbital" radius. The orbits were chosen for effective use of space (Figure 3), since, without making further analysis, all directions around a semantic point are used.

IMPLEMENTATION

The Phaser tool (left side, Figure 1, above) consists of two concentric circles, limiting the user action and the attribute percentage values from 0% (inner circle) to 100% (outer circle), and axes/legs coming from the center of the circle determine, by their size, the projection value and by their angle (phase), the phase of the affected attribute displayed and combined with other attributes. These manipulations of the axes determine the organization of the hierarchy as well as the amount of data exposed manifest in a different way. While the Phaser controls organization of the information hierarchies, the projection canvas (Figure 3) also supports panning and zooming so that Focus+Context+Orientation are all supported. The tool has also been developed to be readily deployed with different visualizations. Shown here is the Phaser used with a list view (Figure 1) and an orbital view (Figure 3).

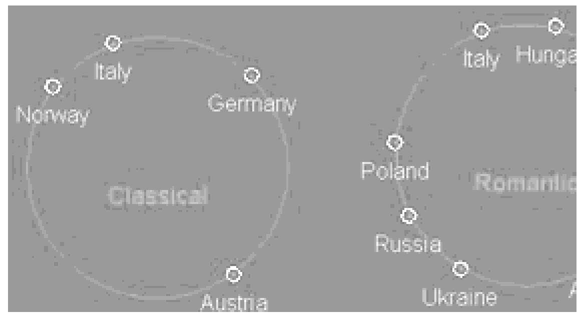

Figure 3. Orbital View privileging Period

EVALUATION AND CONCLUSIONS

The Phaser tool was developed as part of a larger project to evaluate models for exploring high dimensional information spaces, so has not yet been the focus of our research. Observations of 20 participants using the tool for over 20 minutes each to explore an information space showed that they manipulated at least one radial arm of the Phaser more frequently than they either panned around or zoomed into the space. Post experiment interviews suggest that the ability to manipulate the Orientation of the information space may be a valuable addition to Focus+Context tools. The results are encouraging enough that we will be performing additional studies to evaluate the effect of orientation control in particular for improving information exploration and acquisition.

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