Entry Form
eResearch Australasia 2009 Visualization Challenge

TITLE OF WORK
The Dow Jones Animated Parallel Multiverse

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Area of expertise: Information visualisation, HPC, parallel programming

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DESCRIPTION OF WORK

At any instant in time, the stockmarket can be thought of as a many-dimensional space, with the dimensions being quantities such as: the price of each stock, the volume traded, the number of trades, the number and volume of bid/ask orders, and so on. For the 30 stocks in the Dow Jones average, considering just the price and volume of trades gives a 60-dimensional space.

Most direct visualisation techniques can only deal with low dimensional data, that is, up to about 10 dimensions (3 spatial, 1 temporal, plus some variable "visual attributes" such as colour, texture, glyph size/shape). Thus a technique is needed to map this high dimensional space down to a low dimensional one for visualisation.

Parallel Coordinate Plots are a method of mapping such high dimensional spaces to a low dimensional visualisation. Rather than plotting each point in space as the intersection of coordinates on orthogonal axes, parallel coordinate plots draw the axes as a set of parallel lines. A point in the many-dimensional space is then represented as a line joining the corresponding values on each axis.

This visualisation uses an animated parallel coordinate plot to directly show the evolution of the Dow Jones Index stocks during the week of 29 September 2008 to 3 October 2008. The animation, which runs for about 1½ minutes, is similar to a time-lapse video, with each frame showing the state of "multidimensional universe" of Dow Jones stocks during one minute of the week (1500 times faster than real-time). The primary data shown is the change in price of stocks traded, as a percentage relative to its price at the start of the week.[1]

The parallel coordinate plot is augmented in several ways. First, the relative volume of the trades is shown relative to the maximum per-minute trade volume (per stock). These volumes are shown as vertical segments along each stock's axis, with maximum trade volume being represented by a segment half the height of the plot. Second, the Reuters news reports are shown as brief yellow highlights of the relevant stocks' axis which quickly fade, along with display of the headline vertically along the axis. Finally, the average trade price (and 2 standard deviations) is shown as a purple segment along each axis, providing some overall context for the movement of the stocks.

One "free parameter" of parallel coordinate plots is the axis ordering. This visualisation shows the stocks ordered by their (decreasing) relative price change at the *end* of the week. This allows the viewer to follow the progression of the stocks toward their ultimate "position" in the market at the week's end. Other orderings are possible, for example, average trade price, trade price volatility, total trade volume, total trade value, measures of company size, etc.

The data was processed using the awk language, which generated data and scripts for visualisation using gnuplot. The individual frame images were then converted into animations using transcode.

SCIENTIFIC AND/OR COMMERCIAL VALUE

This visualisation presents a very direct view of the data, with only minimal data analysis. This is a deliberate design choice: at its most fundamental, visualisation is supposed to exploit the powerful capabilities of the human perceptual system. There are many features that can be observed in the visualisation, for example:

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1   Bid/ask quote data is not shown, as it was found to be visually indistinguishable from the trade price (consistent with the economic law of one price). Also, there are many trades every second, and the prices of these are averaged, weighted by volume. Shorter timescales could be used for a more direct, detailed view of the data, but this would result in a slower, longer animation.

1. broad market trends, such as when all the DJI stocks collectively move up or down in price, eg. the pronounced drops in price near the end of the first day's trade,

2. "storms" of market activity, such as when many stocks exhibit large trading volumes, eg. the volatile movements near the end of the first day's trade,

3. individual outliers, such as when one stock behaves significantly differently, eg. the substantial Citigroup rally on the 3rd and 4th days – and its subsequent crash at the beginning of trade on the 5th day, or the strong drops of the Bank of America and General Motors,

4. the response of stocks to news, such as large changes in price and trading volume for stocks with many frequent news items, eg. Citigroup and General Electric,

5. the path taken by stocks to their final ordering is not monotonic, as expected, and in particular no such trend starts to appear until the 3rd day, becoming pronounced on the 4th day with only a few outliers,

6. particular behaviour, for example, large drops in price associated with large volumes which correspond to panic selling, compared to large changes in price with small volumes likely to indicate more routine price corrections,

EDUCATIONAL VALUE

The visualisation is useful for demonstrating the concept of parallel coordinate plots and many dimensional spaces. It also helps to educate people about visual language, for example, how the connecting lines of parallel coordinate plots are *not* representative of sensible "in-between" values. Likewise, they also break the convention of indicating the progression of time that is common in other visually similar plots. This helps people to analyse the visual information they are viewing, rather than just glancing at it "on auto-pilot".

The visualisation can also help to educate viewers about the functioning and behaviour of the stock market, for example, high trade volumes in the first few minutes of daily trading (processing of overnight orders), automated trade imbalance news wire items and the subsequent high volumes of trades at the end of daily trading, and real-life illustrations of the economic concepts of shocks, rallies, boom and bust, market movements and behaviours.

LINK TO THE WORK

Please provide a link to the work. If it is protected, please provide the credentials needed to access it.

http://sf.anu.edu.au/~kjp900/er09vis/er09vis-kpulo-dvd-pal-mpg4.mov
http://www.kev.pulo.com.au/er09vis/er09vis-kpulo-dvd-pal-mpg4.mov

Higher resolutions and other formats at:

http://sf.anu.edu.au/~kjp900/er09vis/
http://www.kev.pulo.com.au/er09vis/

The file should conform to the following specifications. Images must be 300 dpi or higher.

	Image(s)	Video and Animation
Minimum	A4 size	352 x 240 pixels
Maximum	A2 size	720 x 480 pixels
File type	TIFF	Quicktime (.mov)

LINKS TO RELATED PROJECTS OR WORKS

You may provide references or related links if relevant.

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