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TimeNotes: A Study on Effective Chart Visualization
and Interaction Techniques for Time-Series Data

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Outline

❖ Time-series Data
  ❖ Chronolens, Stack Zoom
❖ Domain Situation
❖ Data
❖ Visual encoding (TimeNotes)
  ❖ Layout, node manipulation, overlay, annotation
❖ User Study
❖ Advantages & Disadvantage

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Time-series data

❖ One challenge is that screen resolution is small in comparison to data storage capacity.
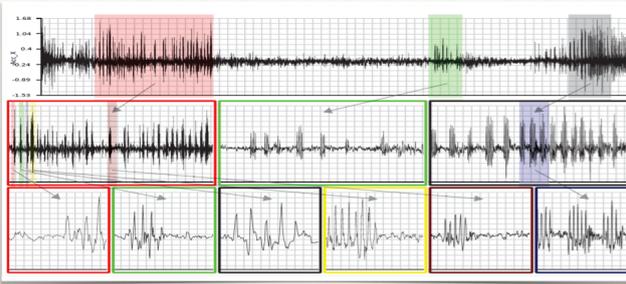
❖ Over-plotting problem

Navigating and communicating through a large data space is an important task. [1]

[1] J.T. Stasko. The value of visualization… and why interaction matters ,capstone speech, euro vis 2014, 2014.

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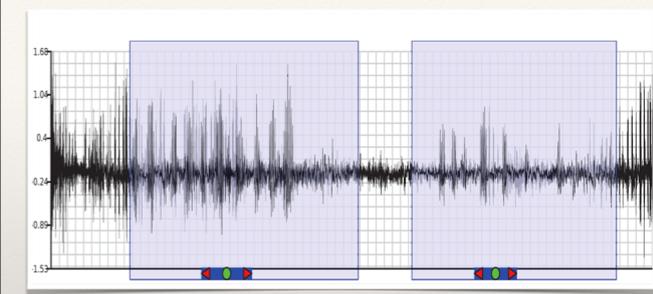
ChronoLens

Chronolenses support more elaborate data analysis tasks, without the need to derive new time series visualizations.

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Stack Zoom

Multi-focus zooming maintains context and temporal distance whilst zooming.

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Domain Situation

Movement ecologists need to explore time-series graphs of several attributes (acceleration, magnetic field intensity, pressure …) to gain an understanding of the mapping from signal to behavior. [1]

How to efficiently extract the signal of interest and annotate them when considering data recorded at a high-frequency over long periods of time?
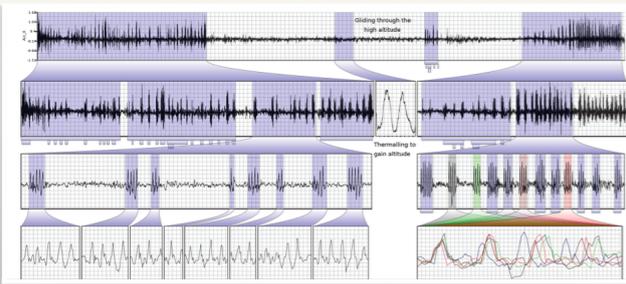
[1] E.L.C.Shepardand L.G.Halsey. Identification of animal movement patterns using tri-axial accelerometry .EndangeredSpeciesResearch,0,10:47–60,2008.

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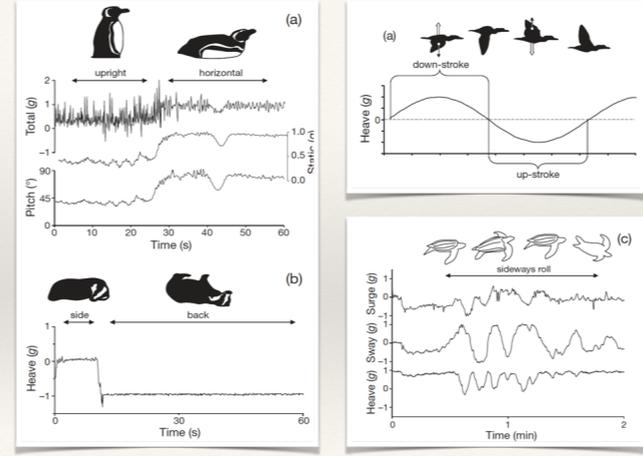
Data

15 minute (approximately) sub-section of remote animal monitoring data obtained from a deployment of a behavioral data collection tag on a Condor consisting of 34,746 data items.
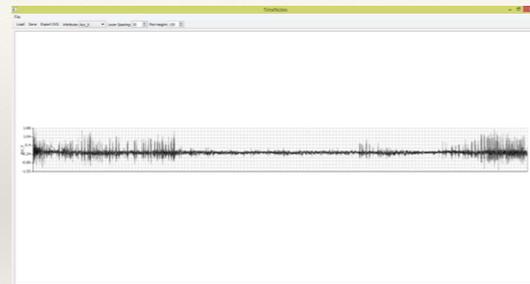
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James Walker

Hierarchical zooming provides an efficient method of navigating through time-series by allowing the user to divide the information space and build a view of only the relevant data at the required granularity which also acts as an implicit graphical history of user actions.
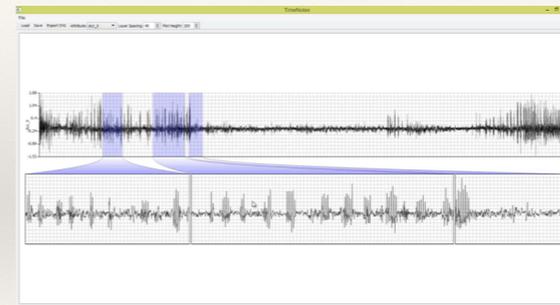
TimeNotes

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Encode - layout

TimeNotes utilizes a space filling node-link diagram to represent the hierarchical zoom structure.
❖ Child node placed below its parent
❖ Allocation of display space proportional to the amount of data represented within that level
❖ Parent-child connection

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Manipulate - node interaction and rendering

❖ Nodes can be resized and repositioned
❖ Panning updates for related children nodes
❖ Bookmark to represent the underlying data.

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Facet: overlay
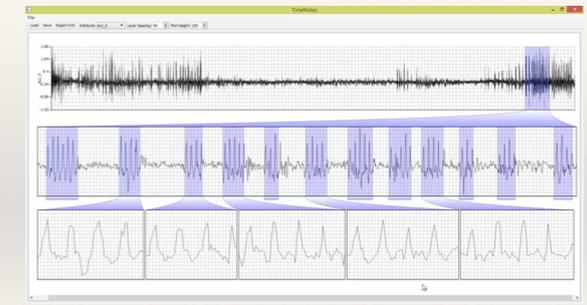
❖ Snapping nodes together overlays the nodes together for better comparison of signals.
❖ Connections are mapped into the overlay plot with unique colour.

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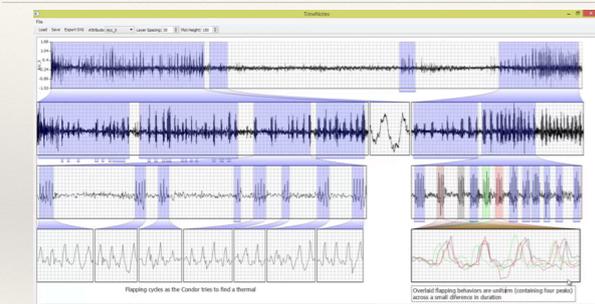
Annotation

❖ Annotations be placed anywhere on the display space.
❖ Annotations move with the node and are hidden when a node is minimized.

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Visual encoding

System	TimeNotes
What: Data	Multidimensional table: multiple qualitative value attribute (signal data), one ordered key attribute (time)
What: Derived	Ordered position of sub-nodes
Why: Tasks	Overview of entire dataset, find patterns/behaviours, compare signals, keep history of actions,construct a presentation view
How: Encode	Space filling node-linked layout, line charts
How: Manipulate	Select patterns across the data-series, navigate with pan, hierarchial zooming, reorder, realign, animated transaction
How: Facet	Superimpose, distinguished with colour
Scale	Ordered key attribute: Ten thousands. qualitative value attribute: one or many

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User study
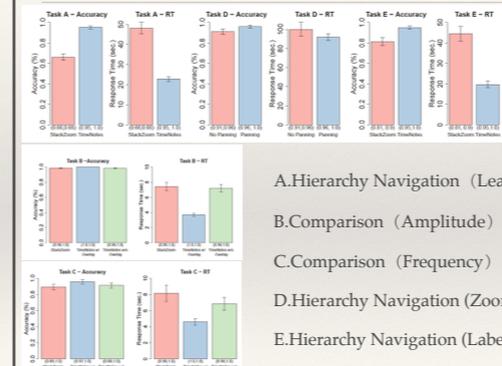
A.Hierarchy Navigation（Leaf Counting）
B.Comparison（Amplitude）
C.Comparison（Frequency）
D.Hierarchy Navigation（Zoom/Pan and Labeling）
E.Hierarchy Navigation (Label Analysis)

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Advantage & Disadvantage

❖ Provide detailed and flexible view for a specific variable dataset

❖ Hierarchical zooming helps solve the conflict of big data size and limited screen, compare and explore behaviour at different scales

❖ Bookmark, annotation and export operations help future reference

❖ Multivariate time-series data is hard to analyze

❖ Missing time axis

❖ Simple plot type

❖ Interval node cannot be hidden with its child node shown

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Thanks!