Visualizing Temporal Adjacency Matrices

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Problem Statement & Motivation

The conventional way of modelling dynamic networks is a series of full graph descriptions, often aggregated or "timesliced". These representations can obscure the finer-grained temporal dynamics.

In contrast, continuous ("event-based" or "temporal") network representations store the individual, timestamped changes (events) in the network, preserving those dynamics.

Meanwhile, the most common approach to visualizing such networks are node-link diagrams, which can become unreadable as networks grow in size and density. For dynamic networks, animation alone struggles with comparing distant timestamps.

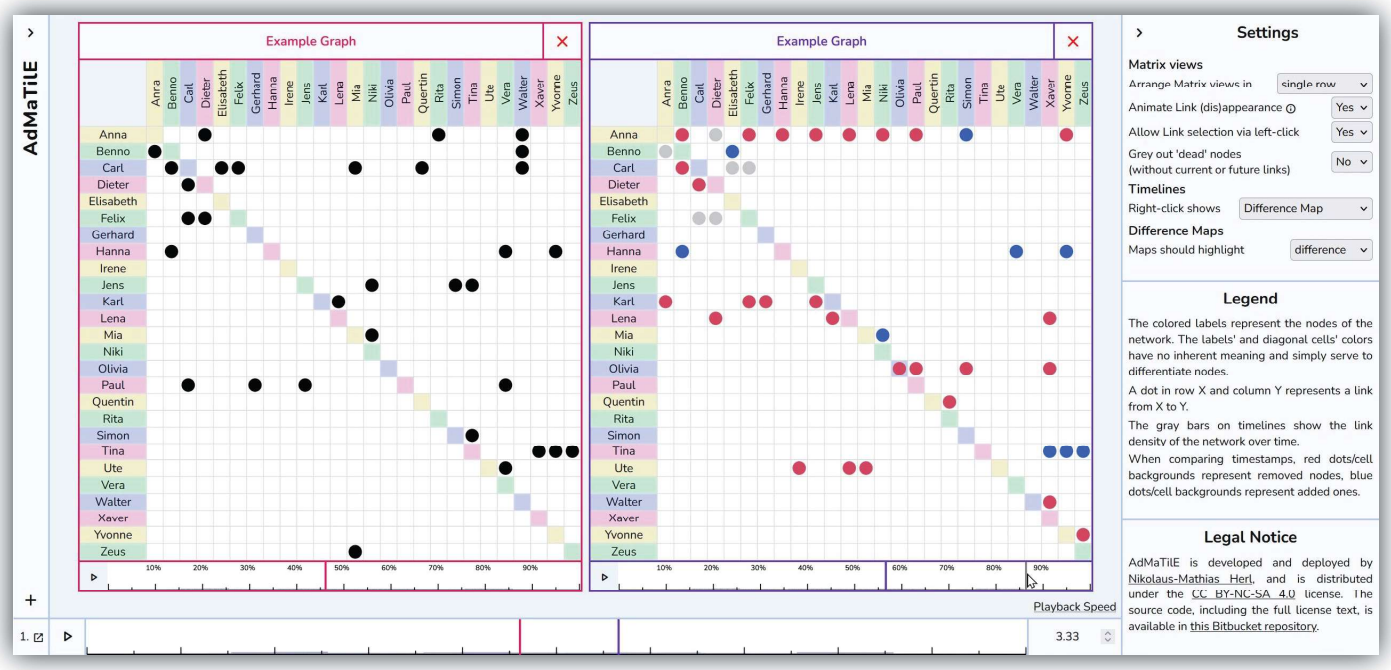

Figure 1: Fullscreen view of AdMaTilE, with two matrix views displaying the same graph. A difference map is evoked on the right. The shown coloring mode visually emphasizes changed links. Another mode emphasizing persistent links is available.

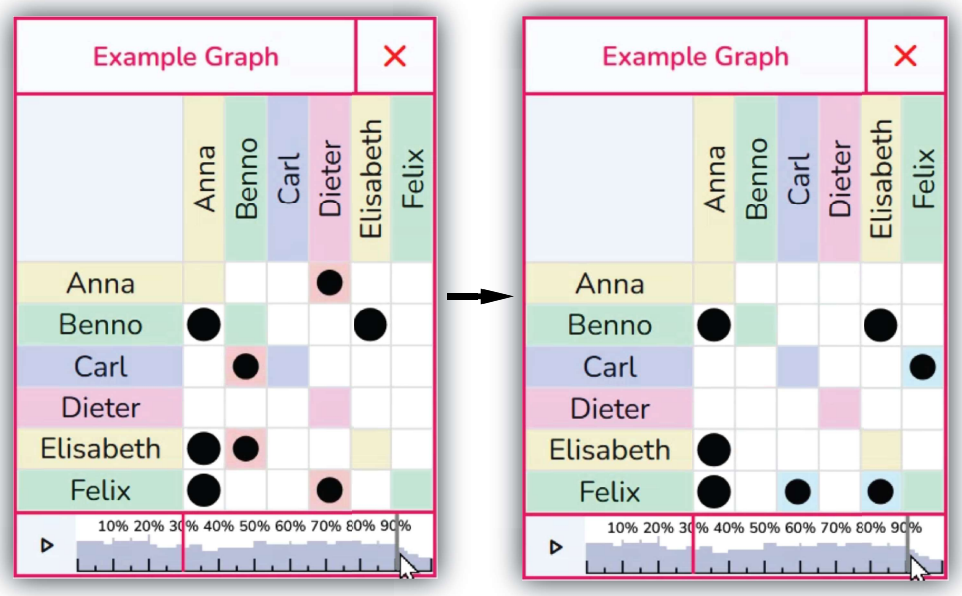

Figure 2: Two snapshots of a staged transition. First, removed link dots are highlighted (red) and shrunk away, then added links are highlighted (blue) and their dots grow to full size.

AdMaTilE: Event-based, Interactive Adjacency Matrices

Our approach visualizes event-based networks in the form of GEXF files, and puts the node-link diagram alternative of adjacency matrices at the forefront.

The system offers interactive views combining adjacency matrices, timelines, difference maps, animated transitions and semantic background coloring. Users can compare multiple graphs and different views simultaneously using a small-multiples approach (see Figures 1 and 3).

Temporal evolution can be viewed through animation, with left-clicking timelines enabling manual time navigation. Right-clicking displays changes between the previously selected and right-clicked timestamps, with support for both staged transitions (see Figure 2) and difference maps (see Figure 1).

Hovering over matrix cells reveals crosshairs, and active links produce a tooltip, absolving users of tracing rows/columns to identify source and target nodes.

Hypothesis: Difference Maps Beat Staged Transitions for Dynamic Data

Given our use and comparisons with AdMaTilE and due to the following traits, we suspect that difference maps are - in most analysis tasks - superior to staged transitions:

- They are are **instant** and continously show the **complete difference information**.
- They thus function well when **brushing** over timelines (e.g. searching for difference extrema)
- They are fully **printable**.

Future Work

- Evaluating AdMaTilE quantiatively against other systems on various analysis tasks.
- Exploring the perceptual traits of (adjacency) matrices further. How can they become more readable (also on path tasks) and insightful?
- Implementing time **range selection**, along with colorful support for **weighted edges**.
- **Node reordering** and **clustering/collapsing**.

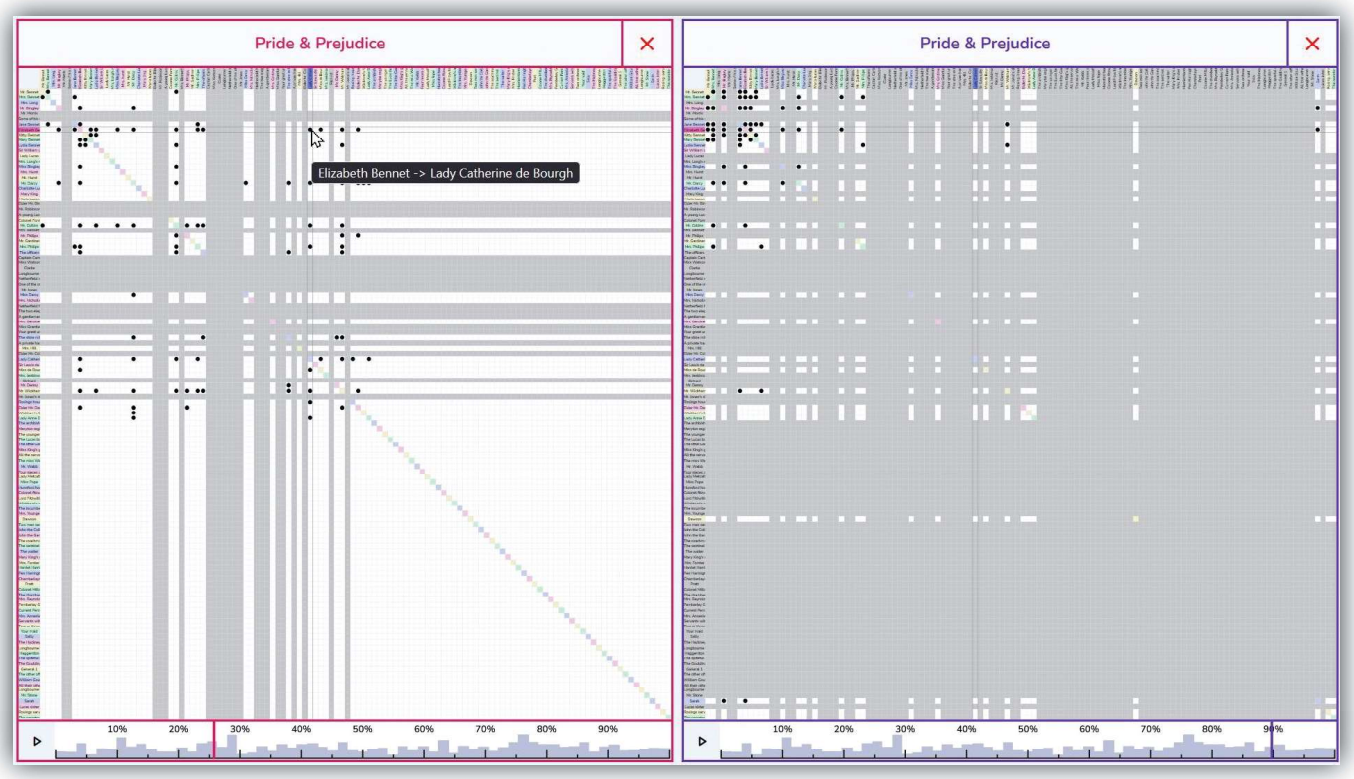

Figure 3: Two snapshots of a character-interaction network. Nodes without current or future link activity are greyed out. This visual mode reveals details about the lifecycle of nodes, and the overall dynamics of the network.

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Live app: Code repo: