Visual Analytics of Dynamic Multi-Relational Networks
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Background
• Social networks are often complex and dynamic
• Members of a network may be connected to each other through different relationships & interactions
• Furthermore, these relationships can change over time

Research Question
• How could the formation and evolution of sub-communities formed through different types of interactions be compared?
• How to discover possible patterns & correlation over time between different interaction modes?

Research Contribution
• Propose a new visual analytics framework, which combines automated analysis, visualisation, and user interaction to discover knowledge from large and varied data, to explore dynamic multi-relational networks
• Implemented a prototype of the system with a web-app format user interface
• Evaluated with real world data sets of cell phone tracking & self-reported relationships within a community (from Reality Commons by MIT Human Dynamics Lab)

Visual Analytics Framework

Analysis
• Clustering on input graphs to discover sub-communities using a hierarchical approach to approximate maximum modularity
• Similarity comparison between subsequent graph clusterings to discover persistent sub-communities with Jaccard index, as well as between persistent sub-communities found within different relations, using averaged Jaccard index over all timesteps

Visualisation
• Storyline: visualisation method used for a selected main interaction, where entities are represented by lines going horizontally along the time axis, with member of a cluster at a timestep grouped vertically together
• AlterClusters: sub-communities within an alternative relation overlaid as colour-coded dots on storylines connected by a vertical line per community
• InterArcs: One-on-one interactions (e.g. phone calls, SMS) shown as arcs with colour value denoting frequency

Interaction
• Selection: switch between different relationship to show as main/sub relations
• Highlighting: on hover of AlterClusters, de-emphasise non-member lines with low opacity
• Comparison: on clicking an alternate cluster, calculates the clusters within all other interactions with similar membership
• Egocentric analysis: only show InterArcs incident on a certain entity
• Zooming: for InterArcs, split a selected timestep to shorter timesteps (e.g month to week) and re-calculate interactions per timestep

Evaluation
Dataset description
• First dataset: phone communication records & friendship surveys of 130+ members of a young-family residential living community
• Second dataset: multiple relationship surveys from 84 residents of a university dorm

Tasks
• Inter-relation comparison: select a sub-community discovered within one interaction mode and compare to similar sub-communities in other interactions
• Graph analysis: Examine possible correlation between the graph structure in the node-link representation with the alternate sub-communities formed
• Interaction pattern discovery: inspect how one-on-one interactions within and across sub-communities differ as well as how the pattern changes over time, with temporal zooming for more fine-grained analysis.