

Situvis

A Visual Tool for Modeling a User's Behavior Patterns in a Pervasive Environment

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Overview

- Situation, Goal & Approaches
- Situvis
 - Sample Data collection
 - Visualization of Context Data
 - Evaluating Situations
 - User Study
- Future Work
- Feedback and Reviews
- Discussion

Situation & Goal

- Support user's goal by making adaptations to their behaviors
 - Accuracy and utility of adaptations are predicated on system's ability to capture and recognize the circumstances
 - System designer has to characterize adaptation opportunities
 - Voluminous, highly multivariate, constantly updated context data
 - Multiple heterogeneous sensors
- Want to recognize high-level “Situations” out of low-level data

Usual Approaches

- Manual specification
 - Too complex
- Machine learning-based approaches
 - Extensive amount of training data required
 - Many situations are subjective and personalized
- Hybrid approach by Situvis
 - Minimal training data to frame situation specification
 - Relevant visualizations to simplify manual process of fine-tuning

Situvis

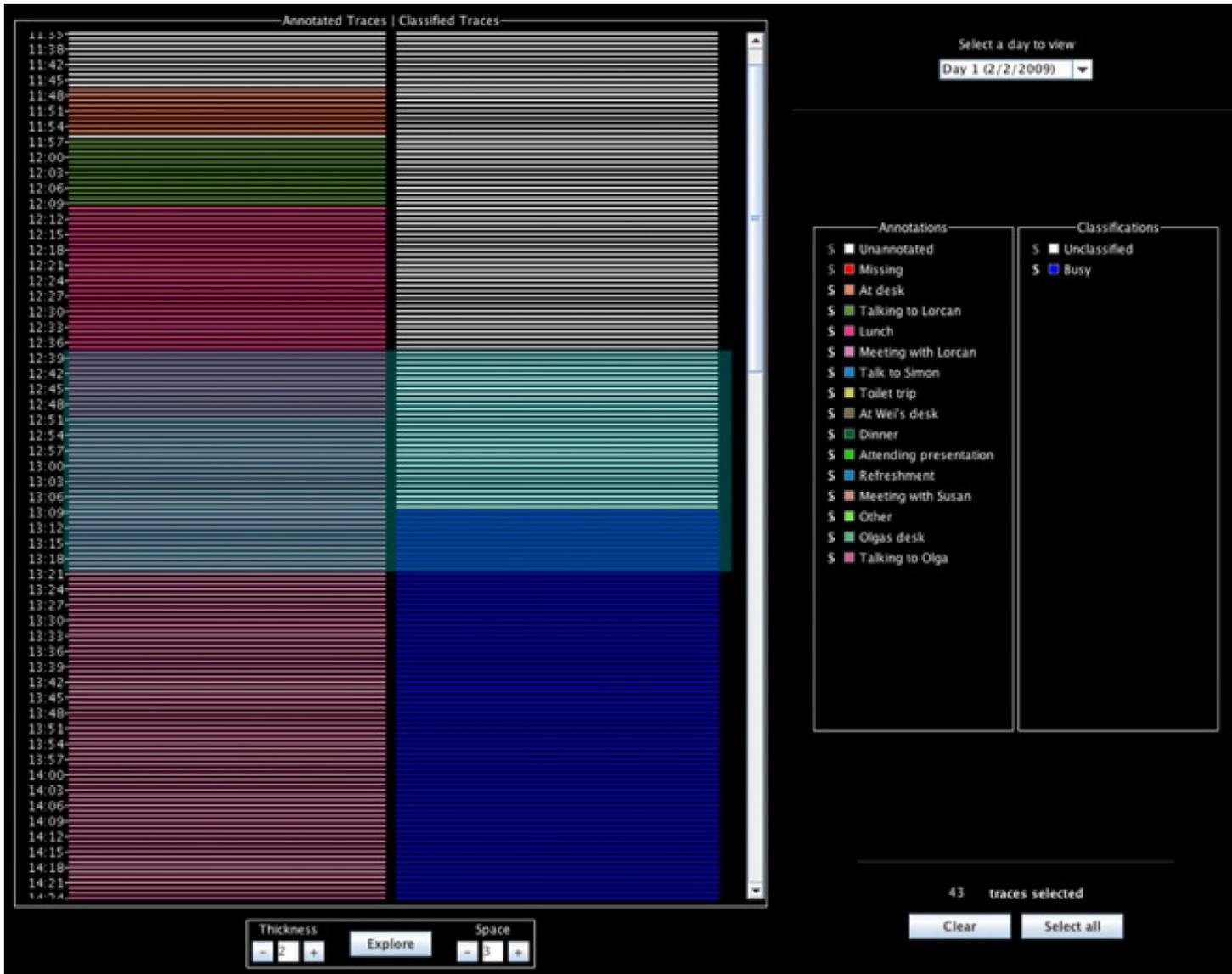
- Interactive visualization tool
 - Visually represents conditions for situation triggering
 - Can visually inspect properties, evaluate and change them
 - Data on high level instead of complex, raw sensor values
- Time-Series Visualization (new version)
- Parallel Coordinates visualization
- Situation specification:

A situation specification consists of one or more assertions about context that are conjoined using the logical operators and (\wedge), or (\vee), and not (\neg). Assertions may comprise further domain-specific expressions on context, given that the required semantics are available.

Data gathering

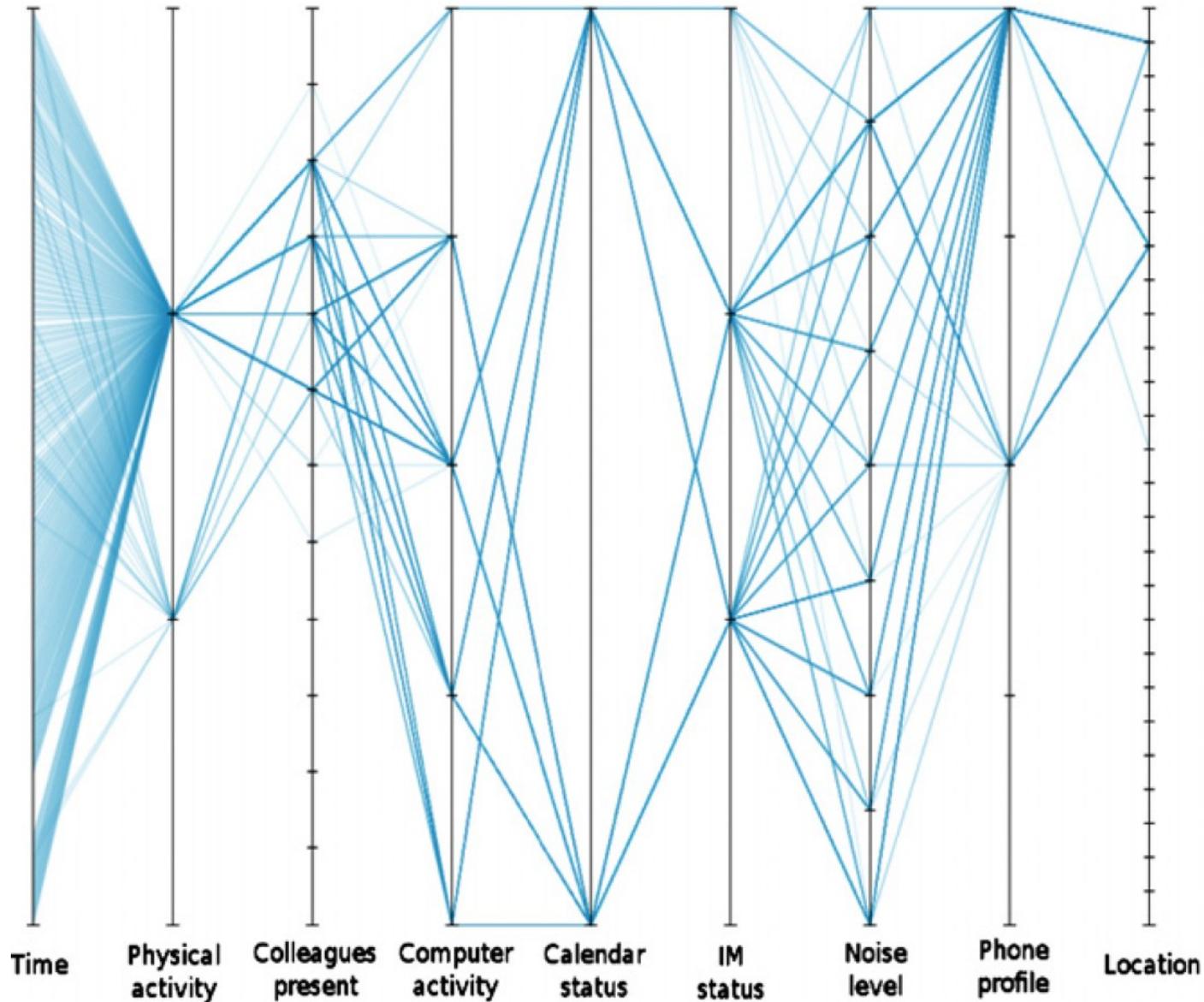
- Context data and situation over 4 days
- Captured Context:
 - Computer activity, calendar entries, instant messenger status, number of colleagues in vicinity, physical activity, noise level, selected profile on mobile phone, location
 - Nokia N95 sensing platform with Bluetooth scan (colleagues), acceleration (activity), microphone (noise level) and phone profile
 - Location with Ubisense (Ultra-wideband location system) and two extra Bluetooth beacons. High-level achieved by
 - Annotations of situations with pen & paper by participant

Time-Series Visualization

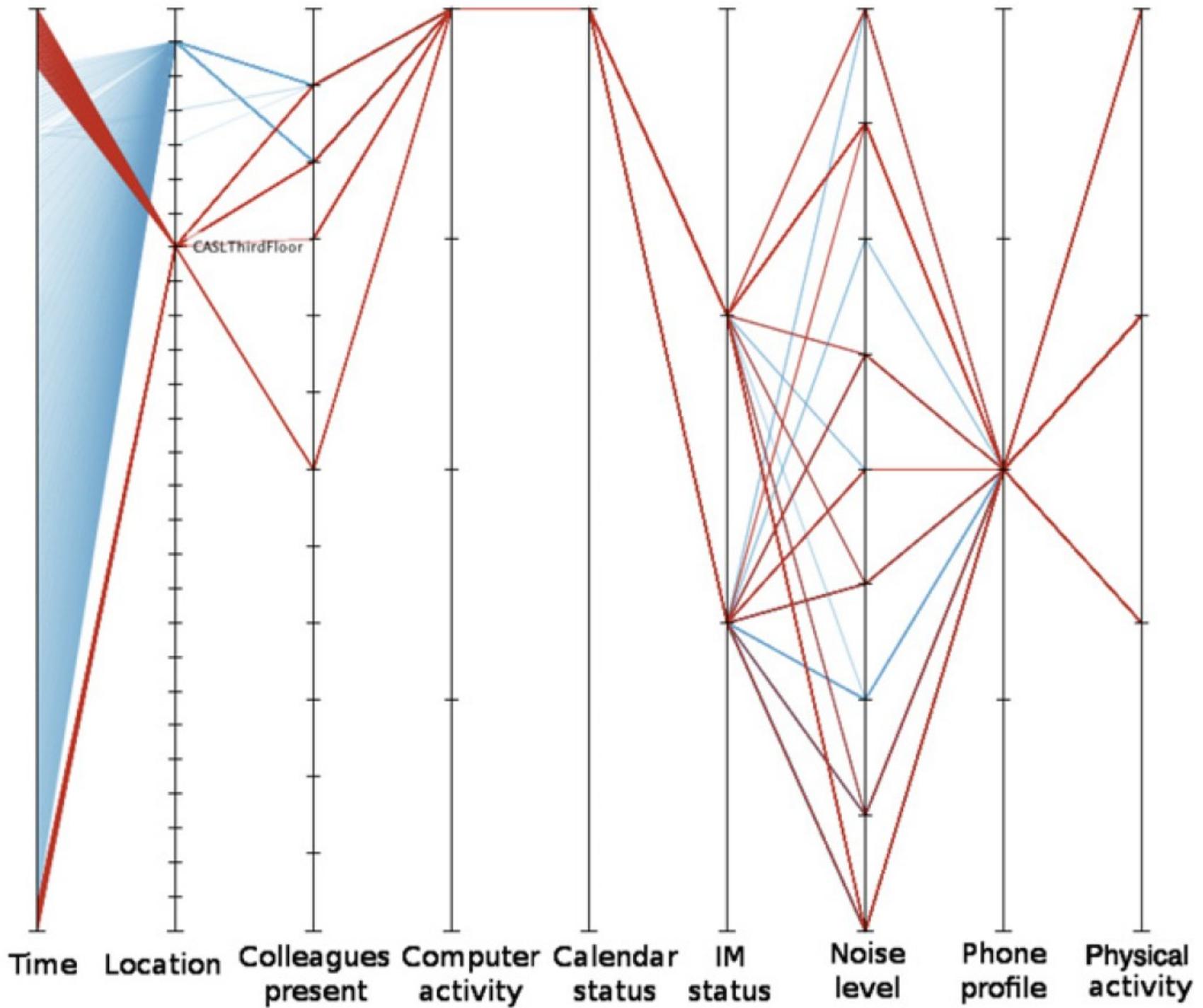


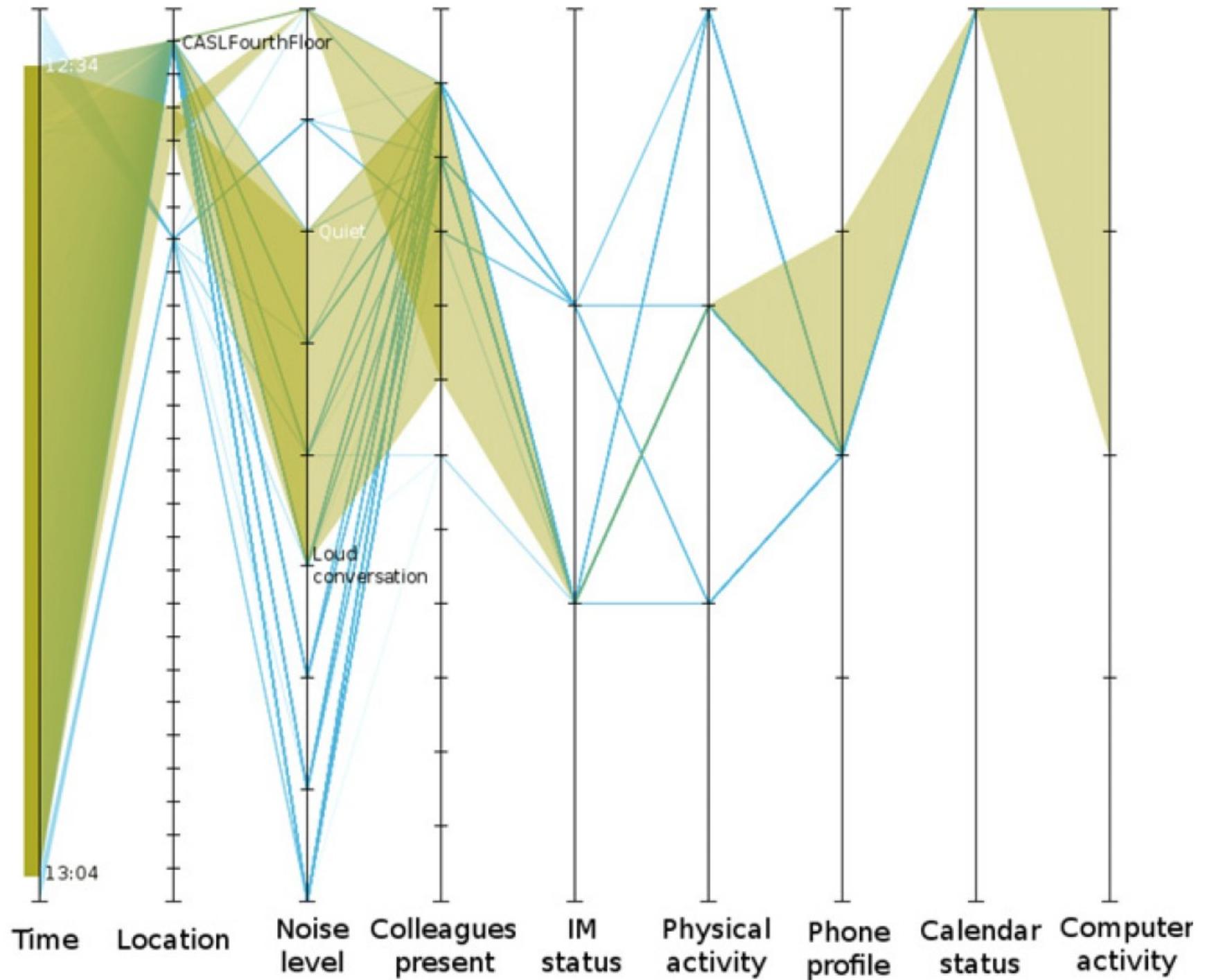
- Annotations
- Classifications
- Brushing

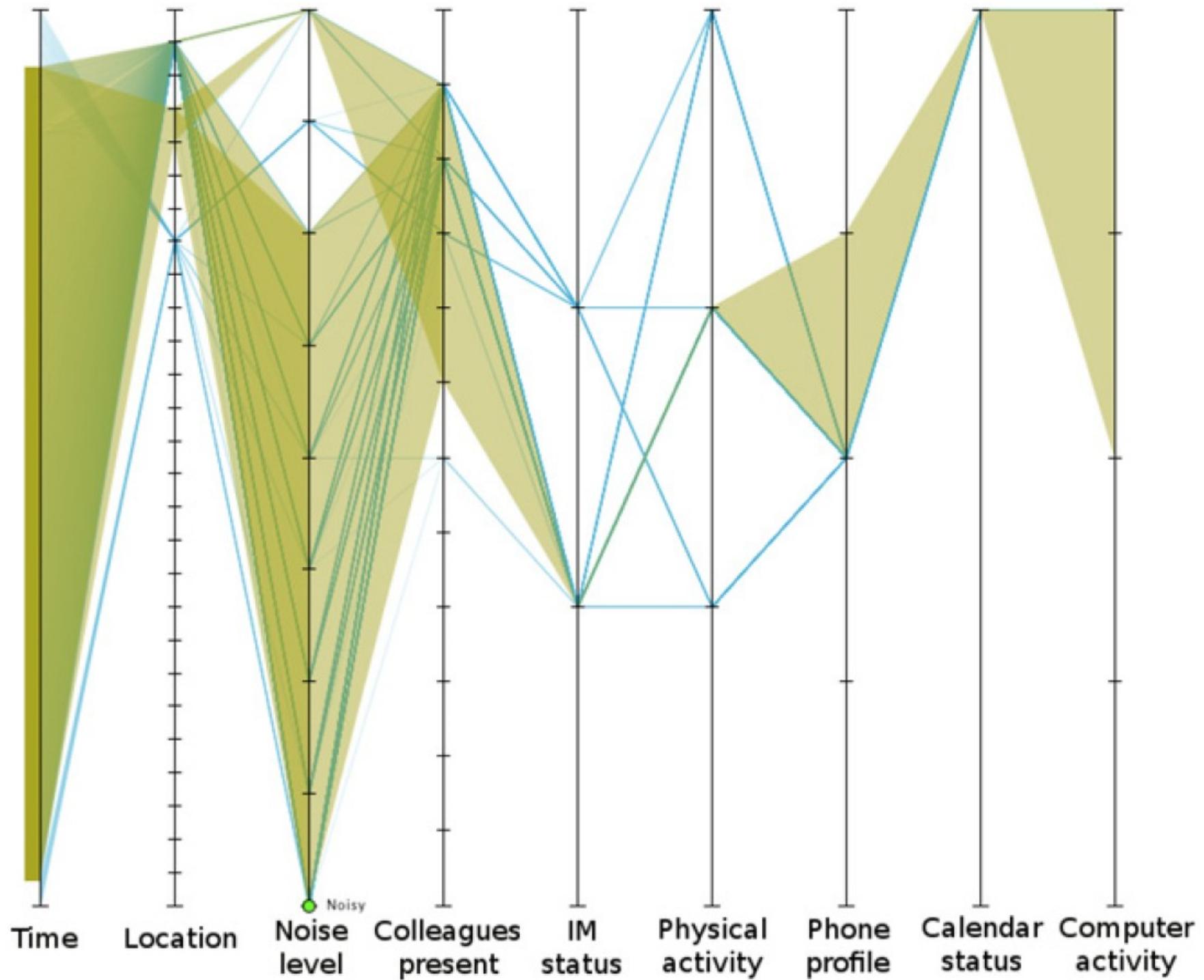
Parallel Coordinates View

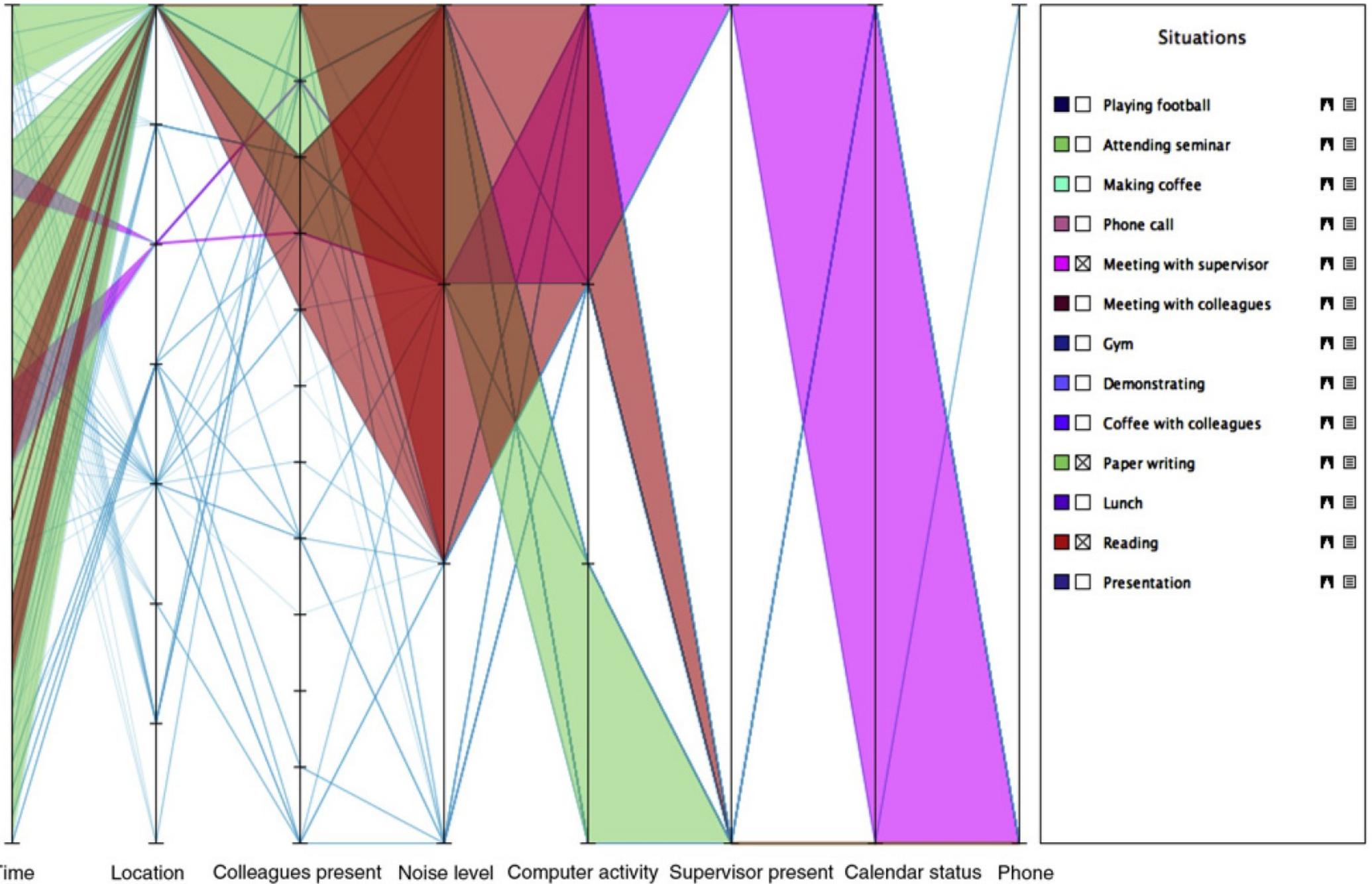


- Axes are attributes
- N-dimensional tuples as data
- Edit and Analysis mode
- Situations panel (not shown here)









Experiments

- User study
 - 10 participants (9 male, 1 female)
 - Situvis vs. Excel (improvised alternative)
 - Measuring time and accuracy for given tasks
 - 4 analysis tasks
 - 2 situation specifications
 - 2 evaluations in relation to the data tasks
 - 2 evaluations to other specification tasks
 - Measure of efficiency and effectiveness

Results 1

- Analysis task
 - Ø 72s (Situvis) vs. 145s (Excel) per task
 - Situvis (100% acc.): TS view & brushing for filtering, reordered axes
 - Excel (93% acc.): lots of scrolling, column sorting, sequential scanning
- Situation specification task
 - Accuracy = percentage of annotated traces that specification classifies
 - False positives = percentages of unrelated situations covered
 - Ø 196s vs. 482s in total (Situvis 60% faster)
 - Accuracy for both ~60%, false positives 22% vs. 33%
- Both significant on 5% level in speed

Results 2

- Evaluating specifications in relation to the data
 - Ø 164s (Situvis) vs. 459s (Excel) per task (64% less time with Situvis)
 - Situvis (100% acc.): TS view to select traces, overlay with specification in PC view
 - Excel (68% acc.): Scrolling to find annotated traces, analyze if satisfied constraints
 - Both in time and accuracy reaching 1% significance level
- Evaluation specifications in relation to other specifications
 - Ø 99s (Situvis) vs. 179s (Excel) per task (45% less time with Situvis)
 - Situvis (77% acc.): overlay relevant specifications in PC view, identify regions semi-opaque areas didn't or did overlap
 - Excel (93% acc.): analyze constraints, identify areas where constraints distinct, partially or completely overlapped
 - Time significantly better with Situvis
 - Situvis 18% less accurate but not significantly worse

Problems & Future Work

- Axes of high dimensional data don't fit on a normal screen
- Number of values for an attribute could be very high
- Situvis' situation semantics are naive – no temporal logic
- Robust probabilistic inference to handle naturally fuzzy data
- Represent all sort of context properties (e.g. 2+-dimensional data) on one single vertical line

Feedback and Reviews

- Review score Ø 1.2 (median 1.5, 12 reviews)
 - (Weak) accept
- Contributions:
 - A new visualization tool to represent the conditions that trigger a situation
 - Minimize annotated samples to frame situation specification by hybrid approach including short ground truth collection period followed by manual fine-tuning by a domain expert
 - Alternative to machine learning approach
- Future work, negative points:
 - Test on existing large data sets with information of several months and especially multiple users
 - Integration in existing data collection systems
 - How does it apply to the development of context aware applications?
 - How to handle changes in behavior?
 - How to detect the cause of a (possibly wrong) routine detection?

Discussion

- What do you think?
 - ... about the user study?
 - ... is the journal paper a better work?
- What could be improved?
- What wasn't clear?

Some reviews

- *“Using Parallel Coordinate Visualizations (PCVs) to show a big amount of data on two dimensions is a original idea, nevertheless I'm sure that the authors are not the first one doing this”*
 - *Indeed: “Parallel coordinates were invented by Maurice d'Ocagne in 1885, and were independently re-discovered and popularised by Al Inselberg in 1959 and systematically developed as a coordinate system starting from 1977.” [1]*
- *“Originality doesn't come from Parallel Coordinate Visualizations, but from implications regarding developer's identification of situations.”*

[1]: http://en.wikipedia.org/wiki/Parallel_coordinates