Feature-based Automatic Identification of Interesting Data Segments in Group Movement Data

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Tatiana von Landesberger, S. Bremm, T. Schreck and D. W. Fellner

Technische Universität Darmstadt
Germany
Motivation

- Analysis of movements
  - Geographic: animals, evacuation, etc.
  - Abstract: assets on financial market

- Focus on group movements
  - Geographic: Animal herds
  - Abstract: Country assets
Motivation

- Analysis of group movements
  - Complex patterns formed from individual movements

Tasks:

- Object within a group
- Individual groups
- Relationship between multiple groups
Related Work

- **Visualization**
  - Animation and trajectories [Andrienko 2000, North 2001,…]
  - Individual points and hulls or distance fields [Schreck 2007 & 2008, Hopf 2003,…]
    - Problem: overplotting & limited perception capabilities

- **Feature-based data analysis**
  - Individual objects [Andrienko et al. 2008, …]
  - One static group [Wilkinson et al. 05 & 06]
  - Multiple groups [von Landesberger et al. 2009]
    - Problems: limited feature set, manual inspection
Approach

- Integrated visualization and data analysis
- Monitoring of data movements with extended feature set
  - Entities within groups
  - Individual groups
  - Multiple groups
- Automatic filtering of interesting movements
Analysis Process

1. Movement visualization
Analysis Process

1. Movement visualization

2. Feature extraction
Analysis Process

1. Movement visualization

2. Feature extraction

3. Automatic identification of interesting movements
Analysis Process

1. Movement visualization

2. Feature extraction

3. Automatic identification of interesting movements

4. Visualization of selection
Movement Features

- **Object within a group**
  - Movement
  - Outlying
  - *Co-movement with the group*
  - Position in the group
Movement Features

- **Object within a group**
  - Movement
  - Outlying
  - Co-movement with the group
  - Position in the group

- **Individual groups**
  - Group distribution
  - Nr. outlying points
  - Group size
  - Group shape
  - Group alignment
  - Group movement

![Graphs showing movement features over time](image)
Movement Features

- Object within a group
  - Movement
  - Outlying
  - Co-movement with the group
  - Position in the group

- Individual groups
  - Group distribution
  - Nr. outlying points
  - Group size
  - Group shape
  - Group alignment
  - Group movement

- Relationship between multiple groups
  - Overlap
  - Distance
  - Relative position
Automatic Identification of Interesting Patterns

- Predefined patterns
  - Extrema
  - Outliers
  - Trends
    - Global
    - Local

- User-defined patterns
Application: Risk-return Analysis

- Application area
  - Analysis of time-dependent asset data
  - Examination of stock market movements
  - Analysis of the relationship between risk and return over time

- Data:
  - Daily stock indicators for a set of assets over several years
  - Monitoring of dynamics on German stock market
Assets in comparison to all German assets (Objects within a group)
Movements of German Market
(Group movement)

Return

Risk

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5. Conclusions

- Visual analysis of group movement data (geographic, abstract)
- Extended approach
  - Combining interactive visualization and algorithmic data analysis
  - New features for movement monitoring
  - Automatic identification of interesting time moments
- Applications
  - Finance, Biology, emergency management,...
- Future work
  - Feature space analysis
  - Movement predictions
THANK YOU FOR YOUR ATTENTION