Data-Driven Approaches for Spatio-temporal Analysis: A Survey of the State-of-the-Arts

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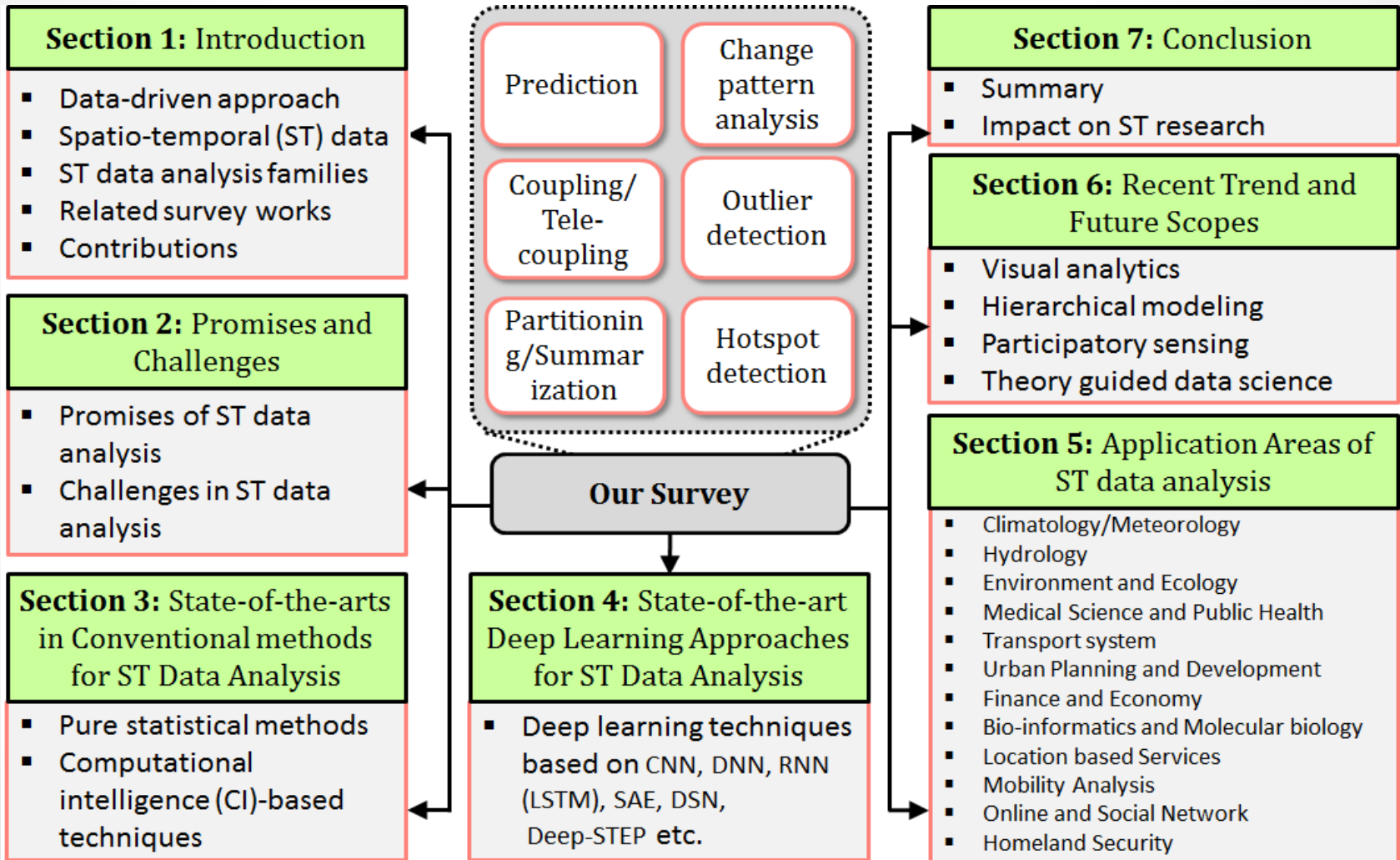
Highlights

- This survey provides a *structured* and *systematic* overview of the state-of-the-art *spatio-temporal (ST) data mining techniques* and their *applications* in various domains.

- The reviewed research articles are considered from *thirteen application areas* and the various data-driven approaches are categorized into *traditional/pure statistical, computational Intelligence-based,* and *deep-learning-based techniques*.

- More than *three hundred* papers, mostly *from 2009 to 2018* are studied to provide a comprehensive review of the present trend of research on *six major families* of ST data analysis

- The survey also provides promising *directions of work in future*.

Survey Organization

Section 1: Introduction
- Data-driven approach
- Spatio-temporal (ST) data
- ST data analysis families
- Related survey works
- Contributions

Section 2: Promises and Challenges
- Promises of ST data analysis
- Challenges in ST data analysis

Section 3: State-of-the-arts in Conventional methods for ST Data Analysis
- Pure statistical methods
- Computational intelligence (CI)-based techniques

Prediction

Change pattern analysis

Coupling/Tele-coupling

Outlier detection

Partitioning/Summarization

Hotspot detection

Our Survey

Section 4: State-of-the-art Deep Learning Approaches for ST Data Analysis
- Deep learning techniques based on CNN, DNN, RNN (LSTM), SAE, DSN, Deep-STEP etc.

Section 7: Conclusion
- Summary
- Impact on ST research

Section 6: Recent Trend and Future Scopes
- Visual analytics
- Hierarchical modeling
- Participatory sensing
- Theory guided data science

Section 5: Application Areas of ST data analysis
- Climatology/Meteorology
- Hydrology
- Environment and Ecology
- Medical Science and Public Health
- Transport system
- Urban Planning and Development
- Finance and Economy
- Bio-informatics and Molecular biology
- Location based Services
- Mobility Analysis
- Online and Social Network
- Homeland Security

Key Contributions

- Focusing on the state-of-the-art techniques from both *analysis family* and *application domain* perspectives.

- *Categorizing* the existing techniques into *hierarchical form*

- Providing extensive coverage of *computational intelligence based* and *deep learning based* techniques

- Concentrating more on the research made in the *recent years* than the work done in the last decades