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Towards an Ontology for Situation Assessment in Environmental Monitoring

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Introduction

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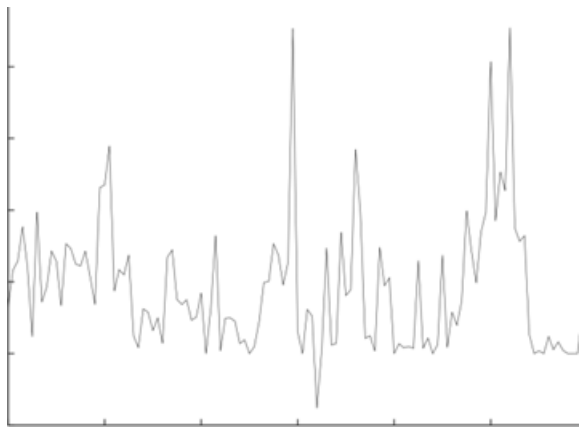
2.0382122539321763e+001  1.6943213617983506e+001
```



Introduction

- Situation awareness
  - Perception, comprehension, projection [4]
- Situation assessment
  - The process of gaining situation awareness
- Military is classical domain of application
- Fairly common in environmental monitoring, e.g.
  - $PM_{2.5}$ monitoring for unhealthy exposure
  - Aerosol monitoring for new particle formation
  - T, RH, WS monitoring for pest outbreak in crops

Introduction

- Build an ontology that is
  - Sufficiently expressive for data in situation assessment
- Situation assessment sub processes
  - Data acquisition: sensors, properties, features, data
  - Data processing: data, algorithms, datasets
  - Knowledge extraction: datasets, models, symbols
  - Knowledge representation: symbols, languages, inference

Approach

- Key data abstractions in situation assessment
  - Sensor observation, dataset observation, situation
  - Temporal and spatial locations
- Ontologies exist
  - SSN: observation, sensor, feature, property
  - QB: observation, dataset, data structure definition
  - STO: situation, object, relation
  - OWL-Time: instant, interval
  - GeoSPARQL: feature, geometry
- Leverage on these ontologies
  - Alignment and extensions

Ontology alignment

- SSN extends DUL
- DUL Entity anything real, possible, or imaginary
- Align ontologies with DUL class hierarchy
- Class alignment, examples
  - Region: Temporal entities and spatial geometries
  - Information object: Datasets and observations, infon
- Property alignment, examples
  - hasRegion: hasGeometry, after, before
  - hasRegionDataValue: asWKT, inXSDDateTime

Ontology extensions

- Distinguish SSN and QB observations
  - Introduced `SensorObservation` and `DatasetObservation`
  - Alignment with SSN and QB observations
- Introduced `SpatialLocation`
  - Distinguish between spatial places and regions
  - Alignment with GeoSPARQL
- Introduced `TemporalLocation`
  - Distinguish between time point and interval
  - Alignment with OWL-Time
- Spatio-temporal locations inspired by Situation Theory [3]

Adoption

- Alignment is used in Wavellite
- Modelling and software framework
- Situation awareness in environmental monitoring
- Support situation assessment implementations
- Applications in various domains

Related work

- Ontologies to represent sensor data and meta data [1, 9]
- Use of STO [2, 5]
- Ontology alignments, e.g. SSN and QB [8]
- Extraction of semantic data from sensor data [6, 7]

Take away

- Proposed alignment more expressive than any of its parts
- Sufficiently expressive for situation assessment
  - Raw sensor data, processed data, extracted knowledge
  - Also meta data about sensor network, dataset structure
- Supports the modelling of space and time
  - Important in environmental monitoring
  - Used in observations and situations
- Support for situation awareness
  - Projection as symbolic knowledge manipulation

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Pictures:
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