

Ontology-Based Data Description and Discovery in a SWIM Environment

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Introduction



• ATM information provisioning and exchange affected by System Wide Information Management (SWIM)



The Vision of Provisioning and Exchange of Information



- SWIM envisions:
 - Collaborative information-sharing
 - Decoupling information provisioning from consumption
 - Global data and communication standards
 - Distributed system based on service-orientated architecture
- SWIM open issues:
 - Filtering and aggregating data for specific purposes not foreseen in SWIM itself
 - No standard for describing data quality, content, etc.

The Vision of Provisioning and Exchange of Information



- SWIM will lead to a marketplace of aeronautical information services
- Information producers :
 - Create, describe, and publish data containers
 - Provide value to consumers accessed over services
- Information consumers:
 - Define a specific information need
 - Discover information services satisfying their needs

Motivation



- Handling decoupling of information provisioning from consumption
 - Consumers and producers are unknown to each other
- Uniform descriptions of data containers and information needs
 - Shared, formal, and explicitly defined vocabulary
 - Compliant with ATM Information Reference Model (AIRM)
- Discovering data containers to satisfy information needs
- Maintaining data containers in the distributed system
 - Provide data in best-effort manner

Basic Idea



- Ontology-based metadata description
 - Discovery, selection, filtering, and composition of data
 - Maintaining the consistency of distributed data
- Producers use metadata to describe data containers
- Consumers use metadata to describe information need
- Common and formally defined metadata vocabulary
 - Metadata terms defined as concepts in a shared ontology
- Use ontology reasoning to support automatic data discovery

Semantic Label







Data Service = http://webservice.austro...

Data Source = ...

Ontology-Based Data Description best



Facet

Facet

Facet



Ontology-Based Data Description



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Ontology-Based Data Description best

- Semantic label of data container defined by ontology concepts
- Semantic label of information need defined by ontology concepts
- Semantic label can be imagined as a complex concept related to other concepts
 → subsumption reasoning can be employed
- Off-the-shelf reasoner automatically derives the subsumption hierarchy between those semantic labels

ightarrow Find most-specific subsuming semantic labels for a given information need



Ontology-Based Data Discovery





Ontology-Based Data Discovery



- Information consumer defines information need using shared vocabulary
- Pilot requires AIXM NOTAMs for Austria in January 31, 2017
- OWL representation of information need:
 - Class: IN1

EquivalentTo: (hasSpatialFacet some Austria) and (hasTemporalFacet some 31January2017)



Ontology-Based Data Discovery





Data Container Templates as Service Wrappers









• Container AUT2 is the most-specific superset



- AUT2 still too coarse to satisfy information need
 - consumer requires additional operations
- Suggest suitable operation based on facet differences
 - Spatial facets on same hierarchy level
 - Temporal facets on different hierarchy levels (2017 subsumes 2017-01-31)
 - → Suggest operation: filterYearToDay(AUT2-dataset, '2017-01-31')





- Utilizing semantic technologies to tackle challenges of SWIM adoption
- Data description supported by an ontology-based metadata vocabulary
- Supporting data discovery employing subsumption reasoning
- Future work:
 - Maintenance of data products with derivation chains
 - Automatic handling of information producer outages
 - Automatized suggestion of operations to satisfy information need



Ontology-Based Data Description and Discovery in a SWIM Environment

Discussion



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- Achieving the BEnefits of SWIM by Making Smart Use of Semantic Technologies
- Support developers of smart SWIM-based applications
- Usage evaluation of semantic technologies
 - Ontology matching
 - Data description and discovery
 - Data distribution and consistency management
 - Scalability of semantic technology
- Goal: SWIM and SESAR AIRM compliant semantic framework facilitating various application scenarios

Ontology-based Data Description



- Semantic labels for description purposes
 - describing data set in a data container
 - describing data set that satisfies information need
- A semantic label consist of metadata terms
- Administrative metadata supports container maintenance
- Descriptive metadata support container description and discovery

Data Container Template Data Model





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Data Container Data Model









Semantic Label Data Model



