

A Semantic System for Rapid Information Search and Access

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Abstract. How to reuse existing data to support applications is an essential issue in various domains. This paper presents semantic approaches to search and access information rapidly in engineering design processes: a Semantic Wiki is built for knowledge annotation and storage, and a knowledge bus infrastructure is designed for heterogeneous data mashup. Applications developed based on them realize the main objectives of the CFMS (Centre for Fluid Mechanics Simulation) project.

1 Semantic Wiki and Knowledge Bus Infrastructure

In a rapidly changing field, the domain knowledge base must be able to keep pace with latest advances. Our Semantic Wiki was built for domain knowledge storage and annotation. This central knowledge base provides an easy-to-use annotation interface and a convenient way of managing structured semantic elements with plain texts. Using a semantic wiki as a knowledge base is a potential approach to offloading the ontology creation and maintenance burden: knowledge experts only need to design an initial ontology, which is a template for domain users to browse, update and manage. The self-maintenance ontology will reflect the community of current interests and priorities in practice.

The knowledge stored and annotated in the wiki is expected to be extracted, combined with data from other heterogeneous data sources to support high-level intelligent applications. A knowledge bus infrastructure was designed to meet the requirement of data integration. The “Bus Controller” manages all the knowledge nodes on the bus. A “back door” to our Semantic Wiki is opened to implement the real-time export of the knowledge annotation elements. Other data sources (e.g. legacy databases, documents) are connected to the bus via their respective RDF wrappers. The semantic gateway is an example of a knowledge consumer on the bus, able to collect required elements from various heterogeneous knowledge providers and assist to implement high-level semantic applications. Considering copyright and security issue in potential scenarios, there is not a central RDF triple stores on the bus infrastructure - only authorized users are able to access required data through a distributed query mechanism. The communication between knowledge nodes on the bus is through a lightweight REST-like interface, and a balance is considered between data source integration and independence.

2 Example Applications

Our Semantic Wiki and knowledge bus infrastructure are adopted to realize the main objectives of the CFMS project (<https://www.cfms.org.uk/>) - providing the ability for engineering knowledge workers to rapidly search and access information like design performance data within their knowledge environment. A Semantic CFD (Computational Fluid Dynamics) Wiki was built for knowledge annotation and storage, and various heterogeneous CFD data sources were integrated with the knowledge bus infrastructure.

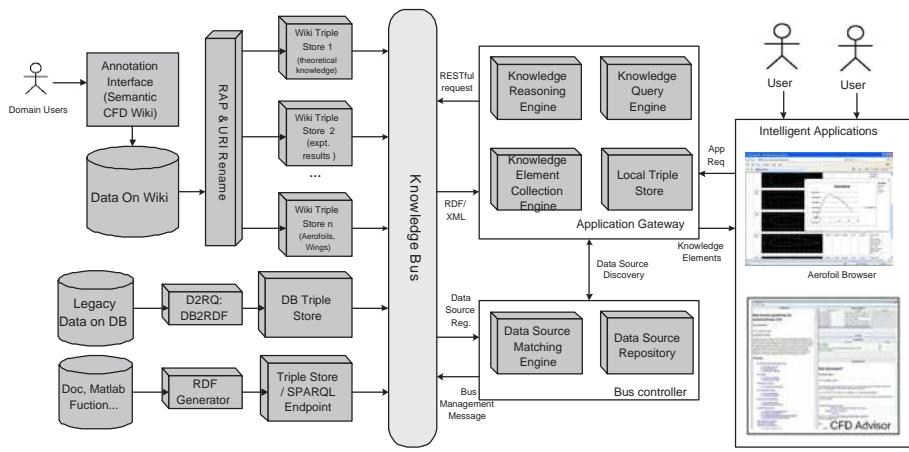


Fig. 1. Semantic Knowledge System for CFD

One of the usage scenarios is Aerofoil Design: when designing an aerofoil, designers may start by selecting an existing aerofoil, and then modifying it where necessary to fit the desired performance requirements. An aerofoil browser has been developed to assist designers to search and locate existing aerofoils in the CFD knowledge space. The browser application demands three kinds of data through the knowledge bus: aerofoil shape data on the Semantic CFD Wiki, previous use record of aerofoils on the conversation database, and aerodynamic constraints on the CFD simulation database.

3 Conclusion

We have designed a semantic system that allows engineering knowledge that is stored in a variety of locations and formats to be searched and integrated. A Semantic Wiki is used as a means to describe the knowledge and to produce the underlying ontology that connects various sources. Knowledge bus infrastructure are used to combine the knowledge from different sources, rather than collecting the knowledge in one place.