





SEMANTIC SUPPORT FOR DSL DEMONSTRATOR IN AN ADDITIVE MANUFACTURING ENVIRONMENT

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MOTIVATION

- A Domain-Specific Language (DSL) demonstrator based on ontology that controls the interaction with the user in an Additive Manufacturing Environment
- DSL lets users query the components of a complicated system without having to learn an unfamiliar query language

AGENDA

- DSL demonstrator: DSLReq
- Ontology AMO
- From ontology to DSL grammar
- Scenario Example
- Conclusions and future work

DSL DEMONSTRATOR: DSLReq



Our framework is structured around four interconnected models:

- AM ontology defines an additive manufacturing domain,
- DSLReq grammar is generated from our ontology,
- User interface, which generates a Cypher query from our DSLReq grammar,
- Semantic graph database based on AM ontology.



ADDITIVE MANUFACTURING ONTOLOGY (AMO)



The methodology of developing an ontology is composed of two steps:

- The reuse of upper-level ontology DOLCE (Descriptive Ontology for Linguistic and Cognitive Engineering) to facilitate the grouping of classes sharing common high-level characteristics.
- The extension of the upper-level branch to additive manufacturing according to our use case

ADDITIVE MANUFACTURING ONTOLOGY: AMMACHINE CLASS



| Active ontology Entities Individuals by class OWLViz DL Query Individual Hierarchy Tab AOWLN OntoGraf SPARQL Query | |
|--|---|
| Annotation properties Datatypes Individuals | AMMachine — http://www.onto4additive.com/onto4add#AMMachine |
| Classes Object properties Data properties | Annotations Usage |
| Class hierarchy: | Usage: AMMachine |
| Asserted - | Show: ✓ this ✓ disjoints ✓ named sub/superclasses |
| • • owl: Thing | Found 360 uses of AMMachine |
| Material Non quantitative value space Object Description Organization Physical object Description Description support Person | AMMachine AMMachine AMMachine SubClassOf mechanismOf only 'AM process' AMMachine Skos:definition "A machine that is designed to enable additive manufacturing processes"@e Class: AMMachine AMMachine AMMachine |
| AM Laver | Description: AMMachine |
| Computer file Feature Mfg device 3DLaserScanner | hasPart only (Material or 'Physical object') |
| AMSupportStructure BuildChamber | hasPart only Object participates In some Presses |
| ► ← BuildPlatform | |
| ► ← EnergySource ← Galvanometer | madeOf some Material |
| ← ← ● MaterialDepositionHead | typeOf only 'Machine type' |
| MaterialFeeder | hasComponent some MfgMachineComponent |
| Mig process | •mechanismOf only 'Mfg process' |
| | hasComponent only MfgMachineComponent |
| Sensor | |
| ► ← ● Product | Machine IN718 10 |
| ► ←● Software | •Machine IN718 11 |
| ► ←● Process | Machine IN718 12 |
| | Machine IN718 13 |
| | Machine IN718 14 |



FROM ONTOLOGY TO DSL GRAMMAR

Each rule of DSLReq grammar consists of an ontology element: concept, relation, or attribute





FROM ONTOLOGY TO DSL GRAMMAR

The request takes as its input the elements in the *Type* rule, operates on them as specified in the *Where* and *Return* rules, and then produces the RDF triple researched by the user:

SCENARIO EXAMPLE



User request:

Get n: AMMachine r: mechanismOf m: AMProcess Where hasHatcingInMicromer of m = 35 Return label of m



Generate

 AMMachine.cypher

 1
 MATCH(n:AMMachine)-[r:mechanismOf]-(m:AMProcess)WHERE m.hasHatchingInMicrometer=35

 2
 RETURN {m_label:m.label }





OntoDSL

The use of ontologies during the design phase



Onto2Gra

The mapping of concepts and relation into grammar productions

DSLReg We define a Domain Specific Language describing the user **Request from** Additive Manufacturing Ontology



CONCLUSIONS

- In this paper, we proposed a query demonstrator able to give appropriate results of user requests by using a DSL grammar. All modules of our system shared a central ontology describing the additive manufacturing domain.
- Ontology is used for building and validation of DSL request. It is also used to support queries for retrieving that knowledge.

FUTUR WORK



Additive manufacturing environment require knowledge contributions from different stakeholders, so it's necessary that software engineering interact with other engineering disciplines.

For that reason, the presented approach needs to be complemented by a set of multiple Domain-Specific Languages.

Each DSL will relate to an engineering discipline

Ontology will provide interoperability between

and will be in interaction with the other DSLs.



DSL manufacturing process

DSLs in our system

DSL client



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