A METHODOLOGY FOR MODELLING OF 3D SPATIAL CONSTRAINTS

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Abstract In this work we demonstrate a new methodology to conceptualise and implement geo-constraints in 3D, which has not been widely explored yet. This is done in four stages from natural language to implementation, in which geometric primitives and OCL play a crucial role to formulate the constraints. A database including various 3D topographic objects (e.g. buildings, trees, roads, grass, water-bodies and terrains) from CityGML (no constraints yet) is used as a case study to apply the developed methodology. In this research, a first attempt to formulate 3D geo-constraints in OCL is made. UML class diagram has been extended with graphical symbols for indicating constraints between classes (in addition to the additional compartment within a class for a class constraint). These constraint expressions can be tested and translated to other models/implementations when the OCL standard is extended with spatial types and operations. During this research, new types of constraints are defined as follows: general-level constraints (applicable to all object sub-classes), parameterised constraints (containing numeric values, e.g. maximum distance), constraints allowing exceptional instances (to resolve cases that have not been defined) and constraints relating to multi-scale representations (to check the consistency between two levels of detail which model the same object). Additionally common sense rules to detect conflicting constraints are specified as well.

Keywords: 3D, Spatial, Constraints, OCL, Database, Model Driven Architecture

A SPATIO-SEMANTIC QUERY LANGUAGE FOR THE INTEGRATED ANALYSIS OF CITY MODELS AND BUILDING INFORMATION MODELS

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Abstract Nowadays, urban planners are facing the challenge that distinct semantic-geometric data models are applied in the architecture/ engineering/ construction domain and in the geospatial domain. However, decision making regarding complex questions of urban planning and engineering requires to combine these two domains and their data models to create a comprehensive information space. Currently, the necessary joint information is created by converting data between the two domains. Since the employed modelling differs conceptually such a conversion results in information loss. To overcome this issue, this contribution presents a spatio-semantic query language that allows to analyze IFC building information models and geospatial CityGML models in an integrated context. Instead of converting between IFC and CityGML, a holistic information space is realized by an intermediate layer that abstracts from the two schemas of spatio-semantic modelling.

Keywords: QL4BIM, BIM, CityGML, IFC, Spatio-semantic query language