

## **Christian Wende: Language Family Engineering with Features and Role-Based Composition**

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### **Kurzfassung:**

The benefits of Model-Driven Software Development (MDS) and Domain-Specific Languages (DSLs) wrt. efficiency and quality in software engineering increase the demand for custom languages and the need for efficient methods for language engineering. This motivated the introduction of language families that aim at further reducing the development costs and the maintenance effort for custom languages. The basic idea is to exploit the commonalities and provide means to enable systematic variation among a set of related languages.

Current techniques and methodologies for language engineering are not prepared to deal with the particular challenges of language families. First, language engineering processes lack means for a systematic analysis, specification and management of variability as found in language families. Second, technical approaches for a modular specification and realisation of languages suffer from insufficient modularity properties. They lack means for information hiding, for explicit module interfaces, for loose coupling, and for flexible module integration.

Our first contribution, Feature-Oriented Language Family Engineering (LFE), adapts methods from Software Product Line Engineering to the domain of language engineering. It extends Feature-Oriented Software Development to support metamodelling approaches used for language engineering and replaces state-of-the-art processes by a variability- and reuse-oriented LFE process. Feature-oriented techniques are used as means for systematic variability analysis, variability management, language variant specification, and the automatic derivation of custom language variants.

Our second contribution, Integrative Role-Based Language Composition, extends existing metamodelling approaches with roles. Role models introduce enhanced modularity for object-oriented specifications like abstract syntax metamodels. We introduce a role-based language for the specification of language components, a role-based composition language, and an extensible composition system to evaluate role-based language composition programs. The composition system introduces integrative, grey-box composition techniques for language syntax and se-

mantics that realise the statics and dynamics of role composition, respectively.

To evaluate the introduced approaches and to show their applicability, we apply them in three major case studies. First, we use feature-oriented LFE to implement a language family for the ontology language OWL. Second, we employ role-based language composition to realise a component-based version of the language OCL. Third, we apply both approaches in combination for the development of SumUp, a family of languages for mathematical equations.