

It's Your Loss: Classifying Information Loss During Variability Model Roundtrip Transformations

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Abstract: This is a summary of a paper (with the same title) originally published at the 26th ACM International Systems and Software Product Line Conference (SPLC) in 2022 discussing the information loss occurring when transforming variability models.

Keywords: Software product lines; variability modeling; variability model transformations; information loss.

1 Summary

Diverse variability modeling approaches have been developed to explicitly capture the commonalities and variability of a set of software systems. Since variability modeling approaches differ especially in terms of scope and expressiveness, it is difficult to assess their properties and find the right approach for a specific use case. Transforming variability models, i.e., of one type to another, would help to better understand and compare existing approaches and would also enable users to switch between approaches. Unfortunately, due to differences in scope and expressiveness, it is difficult to implement transformations without information loss. We analyzed concrete variability modeling approaches, presented a mapping of key concepts between them, and identified and classified the information lost in one-way and round-trip transformations [Fe22]. We evaluated the applicability of our information loss classes by transforming different models of varying sizes and complexity using an existing implementation of transformations⁵. Our information loss classes contribute to a better understanding of different variability modeling approaches, simplify the comparability, and allow users to grasp the impact of transformations.

2 Information Loss Classes

We identified *Conceptual Losses*, i.e., regarding *Configurability* and *Semantics*, as well as *Structural Losses* as distinct information loss classes. *No Information Loss* classifies fully supported transformations [Fe22].

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⁵ <https://github.com/SECPS/TraVarT>

No Information Loss: An entity or a relationship, e.g., an optional feature, can be transformed into another entity or relationship of the target notation with the same semantics, e.g., a Boolean decision, and, hence, can be restored during the round-trip at its full capacity.

Structural Loss: The configuration space of both, the original and transformed model, remains identical, though they are differing in structure. Structure changes because an entity or a relationship, e.g., a conjunction constraint, may not be transformed into an identical entity or relationship, e.g., an implies constraint. This in turn also causes additional entities and relationships in the round-trip model.

Semantic Loss: An entity or relationship could not be transformed into the target language because it is not supported in the target approach, e.g., commonalities in feature models are out of scope for decision models. The configuration space of the original and the transformed model still remains identical.

Configurability Loss: An entity or relationship could not be transformed into the target language because it is not supported in the target approach, e.g., numerical or textual values of decision models cannot be represented as features in feature models. This changes the configuration space of the resulting (target/round-trip) model.

3 Data Availability

We investigated and evaluated the applicability of our information loss classes [Fe22] using a set of existing variability models of different types^{6,7}. Specifically, we transformed 31 feature models, 6 DOPLER decision models, and 3 OVM models into each other.

4 Conclusion

Our evaluation [Fe22] showed that the defined information loss classes can be found in transformed variability models. The classes indicate how information is lost during one-way transformations and round-trip transformations and can therefore help modelers to investigate transformed variability models, increase their awareness of information loss and guide them when developing new transformations.

Literaturverzeichnis

[Fe22] Feichtinger, Kevin; Sundermann, Chico; Thüm, Thomas; Rabiser, Rick: It's Your Loss: Classifying Information Loss during Variability Model Roundtrip Transformations. In: Proceedings of the 26th ACM International Systems and Software Product Line Conference - Volume A. SPLC '22, ACM, New York, NY, USA, S. 67–78, 2022.

⁶ <https://github.com/Universal-Variability-Language/uvl-models>

⁷ <https://github.com/FeatureIDE/FeatureIDE/tree/v3.8.1/featuremodels>