





# **Model Comparison** A Systematic Mapping Study

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Model comparison is the activity of comparing at least two input models.

It can be used for Matching, calculate similarity, clone detection, pattern detection...

Then, this activity plays a pivotal role in Model Driven Engineering (MDE):



#### Current approaches still is not providing a precise and large-scale computation in synchronizing and matching models

Then....

# **Craftsmanship era!**

- A comprehensive understanding about the stateof-the-art is crucial for evolving the current comparison techniques;
- A systematic mapping study to
  - (1) scrutinize those contributions produced over time,
  - (2) characterize previously published model comparison approaches

# **Study Methodology**

#### Search strategy for comparison approaches

 Definition of terms to form Search Strings for performing searches in the main digital libraries

#### Inclusion and exclusion criteria

- $\odot$  Search was limited to studies published in electronic digital libraries;
- $\circ$  No restriction on the publication year of studies until November 2014.
- Papers and studies witch not focus on model comparison;
- $\,\circ\,$  Duplicated studies returned by different search engines; and
- Papers and works that focus in low-level comparison (XML, source code and text).

#### Classify extracted data

- $\circ$  (1) publication date, publication fora, and search engine; and
- $\circ$  (2) basic attributes of studies: main author and title; and finally
- (3) information related to research questions

# RQ1: What are the types of diagrams addressed by comparison techniques?

- Find out the types of diagrams that comparison techniques support;
- Reveal the diagrams that have been considered important

# **RQ1 - Results**

Inside MDE, capability to dealing with many kinds of model are required



- RQ2: What are the data structures commonly used in the comparison algorithms?
  - Pintpoint which data structures are used in the comparison algorithms

# **RQ2 - Results**



- What are the types or categories used for evaluating diagrams in similarity approaches?
  - Understand the different aspects is required to evaluate diagrams:
    - (1) Structural: compare diagrams considering modules and its relationships;
    - (2) Syntatic: comparing taking account the sintaxes of diagrams;
    - (3) Semantic: comparing diagrams considering the meaning;
    - (4) Layout: the comparison approaches aim at view issues;
    - (5) Lexical: implement a name-based model comparison;
    - (6) Multi-Strategy: approahes combine at least two comparison strategies to improve comparison results.

### **RQ3 - Results**



#### • How Fine-Grained are the comparison techniques?

- Grasp how accurate and detailed are the comparison techniques in relation to model signatures:
  - Coarse-grained: low level of detail
  - Partial: a consensus
  - Fine-grained: high level of detail





#### • What are the comparison types?

- Explore what kind of comparison the techniques are responsible for:
  - (1) Matching: Find the correspondent element in another diagrams
  - (2) Similarity: the score of correspondence between elements or between the whole diagram.

#### **RQ5 - Results**



#### **RQ6 - Results**

- Which empiral strategies are used to evaluate the comparison techniques?
  - Check the empiral strategies used to evaluate comparison techniques
    - (1) Evaluation research;
    - (2) Proposal of solution;
    - (3) Philosophical paper;
    - (4) Personal Experience;
    - (5) Opinion paper.

#### **RQ6 - Results**



- Is the approach automatic, semi-automatic or manual?
  - To Summarize the autonomous level of approaches.

#### **RQ7 - Results**



## **Quantity of papers per Event/Journal**

Publication Place	Quantity of approaches	Percentage
IEEE/ACM International Conference on Automated Software Engineering (ASE)	4	10%
IEEE Transactions on software Engineering	3	8%
European Software Engineering Conference and the ACM SIGSOFT	2	5%
International Conference on Software Maintenance (ICSM)	2	5%

### **Publications by year**



### **Rank of authors publications**

Author	Quantity of Papers	Percent
Zhenchang Xing	3	8%
Christian Gerth	2	5%
Hamza Onoruoiza Salami	2	5%
Kleinner Farias	2	5%
Mark van den Brand	2	5%
Segla Kpodjedo	2	5%
Shiva Nejati	2	5%

#### **Combined research questions**



## Threats to validity

- (1) difficulty to relate all works to the topic due the constant changes in publications;
- (2) the conduction of data extraction of the papers, such as:
  - (1) The search string we used has the main terms such as "model" and "matching". However, "matching" and its synonyms (comparison, similarity, etc.) are generic and this string retrieved broad results;
  - (2) The inclusion of thesis and dissertations published online that are not peer reviewed and,
  - (3) The limitation to the main six search engines defined in the SMS planning.

## Conclusion

- This paper identified and classified publication fora, and performed thematic analysis of the existing literature in model comparison.
- The most studies have concentrated more effort on producing generic comparison techniques:
  - 1º There is not a widely-adopted modeling language in industry.
  - 2º The wide variations of modelling notations and diagrams types, it would be challenging to provide an approach that can have a broad adoption.
  - 3<sup>o</sup> Model comparison is not a trivial task to deal with.

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