Dependent Types and Conversion Checking: Literature survey on implementation techniques for type systems

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Background Information

- Dependent types are valuable
  - Allow program verification
  - Add precision to types
- Implementing dependent type theory is difficult
- Difficulty in implementing the conversion checker
  - Type equality depends on term equality [1]
- Conversion checker must also check for term equality
- **Gap in literature:** no existing overview and comparison of implementation techniques

Research Questions

Research Question

- *What different implementation techniques for conversion checking of dependent types have been proposed in the literature?*

Sub-questions

- *What are the advantages and disadvantages of different implementation techniques*
- *Under what circumstances are certain existing implementation techniques recommended over others?*

Method

- *Literature survey* on existing implementation methods
- Techniques compared on:
  - Portability
  - Simplicity
  - Efficiency
  - Decidability
  - Supported Features

Implementation Techniques

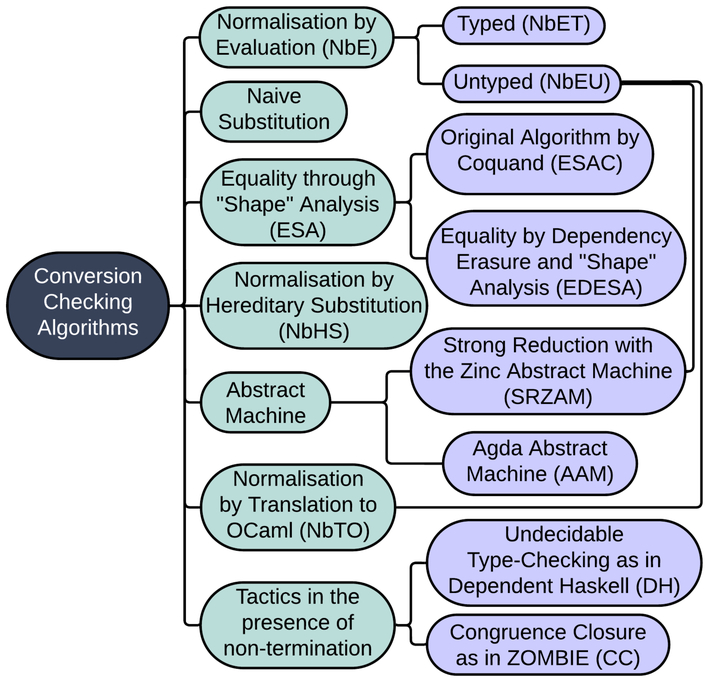

Figure 1. A visual representation of the identified algorithms

Discussion on Features

- **Portability & Simplicity:** Often less efficient
- **Extendibility:** Should verify type system compatibility
- **Efficiency:** Some techniques have been designed for performance, but may come with significant overhead
- **Decidability:** Usually favoured, but there are exceptions

Comparison of Technique Features

Table 1. Technique features (lighter is better, - indicates lack of data)

	P	EX	S	EF	D	SNT
Naïve	-	-				-
NbEU						
NbET						
ESAC						
EDESA						
SRZAM		-				
AAM	-	-	-			
NbTO		-				
NbHS	-	-				
DH	-	-	-	-		
CC	-	-	-	-		

P = Portability, **EX** = Extendibility, **S** = Simplicity, **EF** = Efficiency, **D** = Decidability, **SNT** = Supports non-termination

Limitations

- Most judgements and comparisons are subjective
- Some techniques may have been missed

Conclusion

There are many existing techniques, choice depends on what is wanted from conversion checker.

References

[1] Daniel Gratzer, Jonathan Sterling, and Lars Birkedal. Implementing a modal dependent type theory. *Proceedings of the ACM on Programming Languages*, 3:29, 8 2019.