

# Complexity of Model Checking in Modal Team Logic

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**Abstract.** Modal dependence logic (*MDL*) extends classic modal logic by an atomic dependence operator and was first introduced by Väänänen in [3]. Let  $p_1, \dots, p_n$  be propositional variables. Then we can express with the dependence atom that, on a set of worlds, the variable  $p_n$  is determined by the variables  $p_1, \dots, p_{n-1}$ .

Recently it was shown by Lohmann and Vollmer that the satisfiability problem for *MDL* is *NEXPTIME*-complete ([2]). That the model checking problem is *NP*-complete was shown by Ebbing and Lohmann ([1]).

In this work we study an extension of *MDL*, because *MDL* does not have the expressive power to formulate that a dependence between variables does not hold. For this purpose modal team logic (*MTL*) extends *MDL* by a classical negation operator.

In this paper we consider the model checking problem for *MTL*. In the main result we will show that with the classical negation alternating quantifications, like in *QBF*, can be expressed. This will lead to a *PSPACE* completeness result for the *MTL* model checking problem.

We will also classify the model checking complexity for *MTL* operator fragments. These fragments will mostly be intractable, but we will show that there are also fragments which are tractable and actually parallelizable.

Furthermore we take a deeper look into the influence of the classical negation on the complexity by constraining the nesting depth within *MTL* formulas. Constraining the nesting depth to  $k$ , will lead to fragments which are  $\Sigma_k^P$  or  $\Sigma_{k+1}^P$  complete.

## References

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3. Väänänen, J.: Modal dependence logic. In: Apt, K.R., van Rooij, R. (eds.) New Perspectives on Games and Interaction, Texts in Logic and Games, vol. 4, pp. 237–254. Amsterdam University Press (2008)