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Towards Combined Systems of Modal Logics
— a syntactic and semantic study

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Abstract

This thesis discusses mainly multimodal logics constructed by combining two modal logics. Many monomodal logics have been investigated well. Recently, combined modal logics have been developed and applied in various fields of computer science. Here we focus our attention on multimodal logics obtained by *fusion* of modal logics. Main results on the present thesis are as follows.

First, through Kripke type semantics, we give a complete answer to inclusion relationship between pseudo-Euclidean logics $\mathbf{K} \otimes \{\Diamond^k \varphi \to \Box^m \Diamond^n \varphi\}$ where m and n are fixed non-negative integers, and $k \leq 0$.

Next, we discuss fusions of well-known modal logics. We take up especially preservations of proof theoretic properties for sequent system of fusions without interdependent axioms, and those with some interdependent axioms. An attempt to derive general results on fusions with interdependent axioms, in particular the finite model property of fusions with more generalized interdependent axioms will be made.

Finally, we consider fusions of epistemic logics and temporal logics, which is called *temporal epistemic logics*. Then the subformula property of sequent systems for their basic temporal epistemic logics is shown by the cut restriction theorem and restricting inference rules on temporal notions. Also, Craig's interpolation property and decidability as the proof search procedure are obtained as the consequence.

Key Words: **multimodal logics, fusions of modal logics, temporal epistemic logics, cut restriction theorem, proof search procedure**