Referee report on
Constructive Temporal Logic, Categorically
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submitted to the *Mints Memorial Issue of the IfCoLog Journal of Logics and their Applications*

Conclusion: I recommend the paper for publication in the Mints Memorial Issue after the remarks below are taken into account.

The paper is dedicated to the memory of Grigori Mints. A constructive (or intuitionistic) temporal logic with the categorical model is presented. The paper is kind of a survey that starts from descriptions of several systems using axioms, sequent calculus and natural deduction, next the dual calculus with its properties, and several other systems, finally the categorical model (a cartesian closed category with coproducts and with two intertwined adjunctions) are presented.

In the paper the constructive temporal logic TCS4 is built up in progressive steps beginning with intuitionistic logic LJ. Out of two versions of constructive modal logic S4: the first one, due to D. Prawitz, and denoted by CS4, which does not satisfy the distributivity of the possibility operator $\Diamond$ over the disjunction, and the second one, IS4, investigated by A. Simpson, containing the distributivity and used in the Ewald's temporal logic. The logic described in the paper is a constructive tense logic obtained by by joining together two pairs of Prawitz-style S4 operators, i.e. two CS4's. After that we get a list of systems: dual context modal calculus (DCS4) (which is equivalent, in terms of provability, but it is more type-theoretic), axioms and rules for the systems biCS4, NDCS4, ND2CS4 and the dual context 2CS4, i.e. TCS4 are given. With TCDS4 on page 12 added we get a list of systems which is not easy to follow.

The paper is unbalanced the following sense: the pages 1 -3 and half, containing Preface and Motivation, are written in a story-telling, slow style, and contain basic facts, some known to students of logic, and some not much relevant (like fig.1 and 2). Then there are sections, much less clear: 2. Tense Logic CS4-style. 3. Term assignment and 4. The Categorical Model, with much more advanced and new material but less explanations and presented with an increasing speed.

Here are some remarks and suggestions.

- The syntax of formulas for LJ is defined by the grammar containing the connectives: $\{\perp, \wedge, \vee, \rightarrow\}$, but then there is lack of clearly defined syntax of formulas for TCS4, the tense constructive system, the main topic of the paper, although various kinds of operators $\square$ and $\lozenge$ are used. It would be useful to give, at some point, the grammar for the syntax of the main system TCS4 to avoid some questions like what is the mining of $\times$ in $A \times B$ on the left side of ,,=" on page 12.

- In the Definition 4 (tense calculus model) it is said: ,,a model of TCS4 is a cartesian closed category C (as above), together with two intertwined adjunctions ... The adjunctions ... on C are connected by Fisher-Servi axioms". But ,,Fisher-Servi axioms" are not in the paper, are they so well known? It should be **Fischer** not Fisher. Moreover, the idea of presenting intuitionistic temporal logic as ,,two adjunctions ... that are connected by Fischer-Servi axioms" is not a novelty given by this paper. Looking through the papers: [6], [7] and [8], one can find that this idea appears, perhaps, for the first time in [6], where ,,adjunctions" are replaced by the ,,Galois connections".

- in References, only one publication, i. e. [6], is given as an arXiv -eprints. The ,,official", extended version of [6] has been published in Logic Journal of the IGPL, 22 (2014), pp. 992–1018, better use this.

- page 3, Fig. 1 and Fig. 2 are too small, the letter size makes some parts not readable, but are they relevant to the main topic?

- page 12 line 10 from bottom - replace ,,to to" with ,,to".

With so many definitions given, the paper contains, formally, two proofs, consisting of one (and the same) sentence: ,,This proof hold by straightforward induction on the form of the assumed typing derivation". If all the results are so obvious, are they worth to be published? The paper is written without enough care of readers who are logicians but not categorical logic specialist. With so many systems, specific notions and no proofs it is accessible rather to specialists in categorical logic, then to a wide group of logicians. Some proofs should be presented, to see ,,how this works", not only believe in the authors. Perhaps more explanations would be useful for logicians not familiar with categories.

I recommend the paper for publication in the Mints Memorial Issue, after the above remarks are taken into account.

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