The objective of the doctoral thesis by Tomáš Poch is to make behavioral modeling of components more available. To this end, the author proposes a specification language Threaded Behavior Protocol (TBP) for specification of individual components and supporting composition as well as refinement. I find the topic of the thesis current and interesting from the point of view of the state-of-the-art in the area of component based systems. The language is a step to build a general modeling language for component specification which is user friendly and at the same time has a formal semantics allowing thus for formal verification. TBP can form a basis of a modeling and verification tool for component systems.

The thesis starts with a comprehensive review of available formalisms for describing and modeling component systems ranging from process algebras to automata based models. Based on the reviewed formalisms and their (dis)advantages, the basic features of TBP are stated. These are resemblance to imperative programming languages when specifying the behavior of a component, process algebra (or regular expression) like specification of an environment, both composition and refinement operators, and a formal semantics so that the correctness can be guaranteed.

The description of TBP is then presented in two steps, starting with the syntax. Though the syntax is relatively simply, it provides instruments to describe all key features of components — internal behavior, communication with other components, and provisions declaring the allowed usage of the component. An important (and comparing to many existing modeling languages a very progressive) feature of the TBP language is the support for component's internal threads. Each thread may invoke either required or internal methods. There are several key restrictions given at the syntactical level, namely the restriction on types (only enumerative types are allowed) and the restriction on the number of threads (constant number and all threads are opened at the beginning of the model execution).

The syntax of TBP is accompanied by formal semantics given as a generalized Labeled Transition System (LTSA). Composition of components and their refinement are defined at the LTSA level. The semantic model treats separately the behavior of the
components and their provisions. Correctness of the composed systems relative to the individual provisions is also defined for LTSA. The thesis supplies methods for analysing both closed and open models.

A positive attribute of the TBP language is the way how the three key facets of component systems (internal behavior, communication, environment) are separated. Consequently, for each of them a different description language can be used (see imperative language for internal behavior vs. regular expression like specification of provisions). The semantics of the language is given through transition systems and thus established methods of formal verification can be applied. A questionable attribute is the possibility that the resulting model is not finite-state. This can be restricted syntactically when dealing with data types. However, it is not clear to me whether there is a way how to deal with infinite recursion on a syntactic level.

There are several questions I would like the author discusses during the thesis defence.

- What is your experience with the implementation of the tool for TBP analysis? How did you resolve the problem with finiteness of the TBP model (especially with respect to the recursion)?
- In the Future work section you claim that you plan to generalize the language so that unlimited number of threads can be considered and threads can be dynamically created. Is this possible in such a way that the correctness of a composed system (at least in the sense presented in the thesis) is still decidable?
- Instead of building a new verification tool for TBP it seems possible that you implement just a translation from TBP language to a TBP model in the form of labeled transition system and you input this model to an existing verification tool. Have you considered this method? Do you find it feasible?

The contribution of the thesis is valuable; the presented results are original and nontrivial. Results are nicely presented, constructions are easy to follow. The thesis shows that Tomáš Poch is able to work creatively. The thesis complies with the criteria that are necessary to satisfy in order to obtain the Doctor degree and I recommend the thesis for the defence.

July 22, 2010

Prof. RNDr. Ivana Černá, CSc.