ERCIM "Alain Bensoussan"
Fellowship Scientific Report

Fellow : Lakshmanan KUPPUSAMY
Visited Location : INRIA-Rocquencourt, France
Duration of Visit : February 27– November 26, 2009 (9 months)

I - Scientific activity

In this second phase of ERCIM postdoc, I started with continuing my work on Epistemic logic which I carried out in my first phase at CWI. More specifically, we worked on the following issues.

- Designing formal specifications and checks of epistemic protocols under common knowledge.
- The epistemic protocol for the sequential muddy children can be formalized and verified correctly.
- There exists a correct, deterministic biased protocol for the Russian card problem RCP_{3.3.1}.
- There exists no correct, deterministic and unbiased 2-step protocol for RCP_{3.3.1}.
  The epistemic protocol for the non-deterministic 1-bit secret key generation can be formalized and verified correctly.

The work of this paper was presented in TARK 2009.

After this work, I returned back to my usual research topic MCS formalisms. I worked on generative power of the grammars (based on maximal and depth-first restrictions) which are analyzed for MCS formalisms. Though, In recent decades, there have been some new classes of contextual grammars introduced towards the MCS formalisms, the relationship among these families of languages has not been analyzed so far. Since, all these new classes are obtained by adding the restrictions in choosing the selectors of the derivation and some conditions are in common, it is necessary to analyze the hierarchical relations. With this aim and motivation, I investigated the generative power of these languages and reached an interesting conclusion that all these families of languages are incomparable, but they are not disjoint. The work of this paper was presented in the conference ICTAC 2009.

Besides the above work mentioned, I have also worked with my scientific advisor Prof. Eric de la Clergerie in extending my work on semi-bracketed contextual grammars which I carried-out during my first phase. We showed the important result that this family with regular selectors is a strict subclass of context-sensitive languages. We also discussed the generative power of this grammar with finite and regular selectors and we show that these families are incomparable to the families of languages generated by maximal local and maximal global. We proposed the idea for solving the parsing issue of these grammars using Thread automata.

I also discussed with my advisor in other related issues like Mix languages, dependency grammars, binarization, gap parsing and tree walking automata. Though, we have not obtained any concrete results in these topics, we planned to work on them in future. I am especially interested to work on depending grammars and their relation to Thread automata. Also, I am interested in extending Thread automata to cover the mix languages.

I sincerely thank my Prof. Eric de la Clergerie and INRIA for financially supporting me to visit Boardeaux for participating ESSLLI '09 and to visit Kuala-Lumpur for participating ICTAC '09.

II- Publication(s) during your fellowship

1. Yanjing Wang**, K. Lakshmanan**, and Jan van Eijck, Verifying epistemic protocols under common knowledge, Proceedings of 12th Conference on Theoretical Aspects of Rationality and Knowledge 2009 (TARK '09), 257-266, Stanford, CA, USA, July 2009.
   Abstract:
   Epistemic protocols are communication protocols aiming at transfer of knowledge in a controlled way. Typically, the preconditions or goals for protocol actions depend on the knowledge of agents, often in nested form. Informal epistemic protocol descriptions for muddy children, coordinated attack, dining cryptographers, Russian cards, secret key exchange are well known. The contribution of this paper is a formal study of a natural requirement on epistemic protocols, that the contents of the protocol can be assumed to be common knowledge. By formalizing this requirement we can prove that there can be no unbiased deterministic protocol for the Russian cards problem. For purposes of our formal analysis we introduce an epistemic protocol language, and we show that its model checking problem is decidable.

2. **K. Lakshmanan** and Kamala Krithivasan, On the relative expressive power of contextual grammars with maximal and depth-first derivations, Proceedings of *International Colloquium on Theoretical Aspects of Computing 2009 (ICTAC'09)*, LNCS-5684, 246--260, Kuala Lumpur, Malaysia, August 2009.
   Abstract:
   In the recent years, several new classes of contextual grammars have been introduced to give an appropriate model description to natural languages. With this aim, some new families of contextual languages have been introduced based on maximal and depth-first conditions and analysed in the framework of so-called mildly context sensitive languages. However, the generative power of these contextual grammars and the relationship among these families of languages have not been analyzed in detail. In this paper, we investigate the relationship between the families of languages whose grammars are based on maximal and depth-first conditions. We prove an interesting result that all these families of languages are incomparable to each other, but they are not disjoint.

3. **K. Lakshmanan**, M. Anand and Eric de la Clergerie, On new class of bracketed contextual Grammars, submitted to 'Mathematics, Computing, Language, and the Life: Frontiers in Mathematical Linguistics and Language Theory' (Gemma Bel-Enguix, M.Dolores Jiménez-López eds.).

III -Attended Seminars, Workshops, and Conferences

1. Automata: from Mathematics to Applications (AutoMathA) 2009 held in Liege, Belgium during June 6-8, 2009.

2. 12th Conference on Theoretical Aspects of Rationality and Knowledge 2009 (TARK '09), held at Stanford University, California, USA during 6-9, June 2009.

3. European Summer School on Logic, Language and Information 2009 (ESSLLI '09), held in Bordeaux, France during 20-31, July 2009.

4. International Colloquium on Theoretical Aspects of Computing 2009 (ICTAC'09), held in Kuala Lumpur, Malaysia, 16-20, August 2009.