

# ERCIM “Alain Bensoussan” Fellowship Scientific Report

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Visited Location : CWI, Amsterdam, The Netherlands  
Duration of Visit : May 07, 2008 – February 06, 2009 (9 months)

## **I - Scientific activity**

In my first phase of ERCIM postdoc, I worked on two different areas. One, on mildly context sensitive (MCS) formalisms, an area I have been working in recent times and the second is on Epistemic logic, an area which I was newly introduced by my scientific advisor Prof. Jan van Eijck at CWI. Thanks a lot to him for introducing an interesting research area.

On MCS formalisms, I was interested to define a new formalism in the domain of contextual grammars which could be an appropriate syntactical description for modeling natural languages. In literature, there are some work on contextual grammars related to this MCS formalisms. However, the formalisms based on contextual grammars does not have any derivation tree structure for the derived strings as the one available for context-free grammars and tree adjoining grammars. Thus, its difficult to contextual grammars to analyze the notion of strongly equivalent with other grammar formalisms which has the derivation tree structure. However, the tree structure notion is available for bracketed contextual grammars, but their relevance to MCS formalism has not been analyzed so far. I have introduced a new class of contextual grammars, called *semi-bracketed contextual grammars* which possess the derivation tree structure for derived strings and besides generating context-free languages, they also generate some basic non-context-free languages, thus possessing many good properties of MCS formalisms. Later, myself alongwith Mr. M. Anand of my colleague from India, introduced a new k-queue self-modifying weighted automata to parse these languages. However, we have not reached any polynomial time complexity in the parsing problem and the parsing algorithm is quite complicated. This work need to be improved both from complexity and concept wise.

On my second area, Epistemic logic, initially, I needed to do some literature survey as I was just introduced to that area. I was thrilled to see the role of epistemic logic and common knowledge in the puzzles like muddy-children problem, Coordinated attack, Dining cryptographers and Russian card problems. Though, in literature, the epistemic logic approach has been analyzed in these problems, formalizing and the requirements for designing the epistemic protocols to these problems has never been analyzed, especially when what goal need to be achieved for these problems is made as a common knowledge to the agents. Myself, Prof. Jan van Eijck and his Ph.D student Mr. Yanjing Wang of CWI have decided to work in this problem. After a few discussions with them, we have identified the requirements and formalized the epistemic protocols. When these epistemic protocols are applied to Russian card problems, we obtained some interesting results. As my tenure was getting over by the time, we decided to have some (online) discussions later to get some more results and to make them as a paper.

I thank my group (SEN1) and CWI for providing excellent infrastructure and atmosphere to carryout my research in a fruitful manner.

## **II- Publication(s) during your fellowship**

1. **K. Lakshmanan**, Semi-bracketed contextual grammars, Proceedings of *Workshop on Non-Classical Formal Languages in Linguistics 2008 (ForLing'08)*, 41--55, Tarragona, Spain, Sept. 2008.

### **Abstract:**

Bracketed and fully bracketed contextual grammars were introduced to bring the concept of a tree structure to the strings by associating a pair of parentheses to the adjoined contexts in the derivation. In this paper, we show that these grammars fail to generate all the basic non-context-free languages, thus cannot be a syntactical model for natural languages. To overcome this failure, we introduce a new class of fully bracketed contextual grammars, called the semi-bracketed contextual grammars, where the selectors can also be non-minimally Dyck covered language. We see that the tree structure to the derived strings is still preserved in this variant. when this new grammar is combined with the maximality feature, the generative power of these grammars is increased to the extend of covering the family of context-free languages and some basic non-context-free languages, thus possessing many properties of the so called 'MCS formalism'.

2. **K. Lakshmanan**, M. Anand, A new automata for parsing semi-bracketed contextual grammars, 1st International Conference on Computer, Communication, Control and Information Technology (C3IT 2009), Hoogly, Kolkata, India, Feb 2009. Published in the proceedings of the conference.

### **Abstract:**

Bracketed and fully bracketed contextual grammars were introduced to bring the concept of tree structure to the strings by associating a pair of parentheses to the adjoined contexts in the derivation. But these grammars fail to generate the basic non-context free languages thus unable to provide a syntactical representation to natural languages. To overcome this problem, a new variant called semi-bracketed contextual grammar was introduced recently, where the selectors can also be non-minimally Dyck covered strings. The membership problem for the new variant is left unsolved. In this paper, we propose a parsing algorithm (for non-projected strings) of maximal semi-bracketed contextual grammars. In this process, we introduce a new automaton called k-queue Self Modifying Weighted Automata (k-quSMWA).

## **III -Attended Seminars, Workshops, and Conferences**

1. European Summer School on Logic, Language and Information 2008 (ESLLI '08), held in Hamburg, Germany during 4-15, August 2008.
2. *Workshop on Non-Classical Formal Languages in Linguistics 2008 (ForLing'08)*, held in Tarragona, Spain, 19-20, September 2008.
3. Workshop on Logic and information Security, held at Lorentz Center, Leiden, The Netherlands, 22-26, September 2008.
4. 1st International Conference on Computer, Communication, Control and Information Technology (C3IT 2009) held in Hoogly (Kolkata), India, 6-7, Feb. 2009.