



## **PhD Thesis Proposal Form China Scholarship Council (CSC)/ENS Rennes Call for projects 2018**

**FIELD open**

Thesis subject title: Applied Logics Based on Plausibility for Reasoning about Uncertainty

- Laboratory name: IRISA
- PhD supervisor (contact person):
  - Name: Guillaume AUCHER
  - Position: Associate professor
  - E-mail: guillaume.aucher@irisa.fr
  - Phone number: +33 (0) 2 99 84 22 60

- 
- Thesis proposal (max 1500 words):

### **Context:**

Numerous formalisms have been introduced in Artificial Intelligence to represent the uncertainty that an agent or a group of agents have about a given situation: probability measures, possibility measures, ranking functions, preferential structures, just to name a few. Friedman and Halpern (2001) showed that all these formalisms are in fact instances of a more general formalism: plausibility measures. The way the agents update their uncertainty about the situation after the occurrence of events or after incoming information is formalized by means of some sort of conditional plausibility measures.

Independently from this research line, numerous logics for reasoning about uncertainty have been developed in a research area known as Dynamic Epistemic Logic (DEL). Many of these logics are extensions of epistemic logic or modal logic and they include sometimes some refined representation of uncertainty based on probability or ranking functions for example. Moreover, they often deal with situations that involve multiple agents, which are more difficult to handle and to reason about in general.

### **Objectives:**

- The first objective is to reformulate the extensions of DEL with probability, ranking functions, etc. within the framework of Friedman and Halpern (2001) based on conditional plausibility measures. In particular, this implies a reformulation of the various update mechanisms that have been proposed in DEL as some sorts of conditional updates, such as public announcements to all agents, private announcements to some agents, semi-private announcements, deceptions, lies, etc. This will give rise to a family of logics which are all extensions of the same generic logic whose semantics is based on conditional plausibility measures.
- The second objective is to develop a correspondence theory that would relate the properties of these update mechanisms expressed in first-order logic with axioms or inference rules of the generic logical framework based on conditional plausibility measures developed in the first part of the PhD. This correspondence theory would allow to characterize the different update mechanisms in terms of axioms or inference rules and it would provide means in order to define actual update mechanisms.
- The third objective is to specify, design, develop and test a software tool that would be based on the generic logic developed in the first part of the PhD and the correspondence theory developed in the second part of the PhD. This software tool would allow a user to answer and solve some decision problems (such as theorem proving or model checking) related to a specific logic defined by the user and based on the various properties elicited and identified in the second part of the PhD and that extends the generic logic elicited in the first part of the PhD.

The modularity and versatility of the software tool, which is not related to a single logic but to a family of logics, should ease the transfer and usability of the important amount of work that has been pursued in logic for reasoning about uncertainty in the last 30 years.

#### *Bibliography:*

- Friedman, N. and Halpern, J. Y. (2001). Plausibility measures and default reasoning. *Journal of the ACM*, 48(4):648–685.
- Friedman, N., and J. Y. Halpern (1997). "Modeling Belief in Dynamic Systems, Part I: Foundations." *Artificial Intelligence* 95: 257 – 316.
- Aucher, G. (2003). A Combined System for Update Logic and Belief Revision. Master's Thesis. ILLC University of Amsterdam.
- Aucher, G. (2007). "Interpreting an Action from What We Perceive and What We Expect." *Journal of Applied Non-Classical Logics* 17: 9 – 38.
- Baltag, A., and S. Smets (2008). "A Qualitative Theory of Dynamic Interactive Belief Revision." *Logic and the Foundations of Game and Decision Theory (LOFT7)*. Eds. G. Bonanno, W. van der Hoek, and M. Wooldridge. Amsterdam: Amsterdam University Press. 11 – 58. Vol. 3 of *Texts in Logic and Games*.
- Van Benthem, J. (2007). "Dynamic Logic for Belief Revision." *Journal of Applied Non-Classical Logics* 17.2: 129 – 155.

1. Yanjing Wang, Guillaume Aucher. An Alternative Axiomatization of DEL and Its Applications. *IJCAI - International Joint Conference in Artificial Intelligence - 2013*, Aug 2013, Beijing, China. 2013. [〈hal-00856470〉](#)
2. Guillaume Aucher. Dynamic Epistemic Logic in Update Logic. *Journal of Logic and Computation*, Oxford University Press (OUP), 2016, 26 (6), pp.1913-1960. [〈10.1093/logcom/exw002〉](#). [〈hal-01476249〉](#)
3. Guillaume Aucher. Displaying Updates in Logic. *Journal of Logic and Computation*, Oxford University Press (OUP), 2016, 26 (6), pp.1865-1912. [〈10.1093/logcom/exw001〉](#). [〈hal-01476234〉](#)
4. Guillaume Aucher. Intricate Axioms as Interaction Axioms. *Studia Logica*, Springer Verlag (Germany), 2015, pp.28. [〈10.1007/s11225-015-9609-0〉](#). [〈hal-01193284〉](#)
5. Guillaume Aucher. Logic and Commonsense Reasoning: Lecture Notes. Master. Rennes, France. 2017, pp.151. [〈cel-01586568〉](#)

- 
- Joint Phd (cotutelle) : NO
  - Co-directed PhD : YES

In case of a co-directed or a joint PhD, please detail:

- Partner university name: Peking University
- Laboratory name and web site: Department of Philosophy, <http://english.pku.edu.cn/>
- PhD co-director (contact person):
  - Name: Yanjing WANG
  - Position: Associate Professor
  - E-mail: [y.wang@pku.edu.cn](mailto:y.wang@pku.edu.cn)
  - Phone number: (8610) 6275 1670

- 
- Provisional duration and timetable of the PhD student's stay at ENS Rennes:  
4 years in Rennes (2018-2022).
  - If previous collaborations with the Chinese co-director/university, please detail:
    - Joint publication at the international conference IJCAI 2013
    - Visit of Yanjing WANG at IRISA in June 2017 (a seminar was organized).

- Participation of Guillaume AUCHER to a workshop organized by Yanjing WANG at Beijing University in 2013
  - Numerous exchanges, emails and discussions at conferences and other places since 2005.
- Interest of the Joint PhD for the French co-director, for his/her laboratory, for ENS Rennes:
- For the French co-director: continuation of a nice collaboration with possibly more interactions.
  - For his laboratory / ENS Rennes: possibility to have more interactions and exchanges with Peking university.

Date: 15/01/2018

Signature of the PhD director



Guillaume AUCHER

Name and signature of the Laboratory director



Jean-Marc Jézéquel  
Directeur de l'IRISA