

RESEARCH UNIT NUMBER 1 / 601

COORDINATOR Amílcar dos Santos Costa Sernadas

RESEARCH UNIT NAME CLC - Centro de Lógica e Computação
Instituto Superior Técnico da Universidade Técnica de Lisboa

Mathematics

PANEL MEMBERS Jean-Pierre Bourguignon, David Cox, Roland Glowinski, Gérard Huet, Thomas Laffey, Jalal Shatah, Carles Simó, Vera T. Sós, Joel Spencer, Tamas Terlaky, Irene Fonseca (Coordinator)

Overall Research Unit Quality

Excellent Very Good Good Fair Poor

Comments and recommendations regarding the Unit activities, research orientation, organization and application of funds

Mathematics *Very Good*

The rating of this Center is to be read as Very Good +.

This is a young center, resulting from a split of the CEMAT. Its research agenda is focused on the areas of Logic and Theory of Computation. Presently the emphasis is more on Logic than on Theory of Computation, but the panel interprets the designation of the Center, Centro de Lógica e Computação, as a token of interest and intention to diversify towards Fundamental Informatics, as part of a long term strategic plan.

Nowadays the focus is a bit narrow, and possibly too restricted on rather abstract topics, not particularly relevant to applications. Contemporary mathematical logic is developing very fast in the areas of Constructive Type Theory, Linear Logic, and Hybrid Modal Logics, three areas which are essentially absent from the current lines of research in the Center.

The study of fibring, or more generally modular composition of logics, is important and of high quality. It provides powerful tools for proving meta theoretical properties, such as completeness, through the use of preservation lemmas. However, the researchers ought to make sure that their modular constructs do not reduce to abstract unrealistic entities, and can be applied to useful implemented formalisms, such as ML's modules and functors, and similar modular constructs in existing high-level programming environments or proof assistants. Only this way their research may contribute to the important emerging computational paradigms. A promising application area for fibring is hybrid logic, a recent development of modal logic particularly relevant to computational linguistics and state transition systems. This topic has started to be addressed in some papers of the group, and the panel recommends that it be pursued.

The work on process algebras, and more generally paradigms of distributed computation, is important, but the state-of-the-art in this area is moving fast--the team ought to consider recent extensions of pi-calculus for mobility, such as the Join Calculus of Gonthier, Lévy and Maranget.

The ongoing research on quantales is more algebraic, with intriguing use of C*-algebras, and combinatorial applications including Penrose tiles. This study should be related to models of linear logic such as coherent spaces. Thomas Ehrhard, from the Luminy Mathematical Center, would be a good contact for helping understanding such a connection.

The work on complexity through functional analysis is highly original, and thus risky, but intriguing.

The panel recommends that the team builds up by hiring post-docs and inviting long-term visitors, preferably in areas not already covered by the Center. A cooperation with the Type Theory team from the Centro de Matemática in Minho-Braga could be a good way to open the group towards topics in constructive logic. Also, there is a potential for strong interaction of the Center, except possibly the complexity part, with the group of logicians at CMAF working on abstract complexity. A synergy may be developed through the organization of joint seminars.

The panel also recommends that the Center establishes stronger links with Theoretical Computer Science groups, so as to avoid missing important opportunities. In particular, work on security modeling is being conducted by several strong groups in computer science departments worldwide (many of which European). These teams are able to establish relevant cooperations between logicians and software companies, e.g. in the development of certified protocols for smartcard applications. Another hot area of application of logic is the verification of hardware arithmetic, for instance by John Harrison at Intel Labs.

The panel understands that the researchers in this Center are primarily driven by mathematical interests. However, the building of collaborations with more applied logicians and computer scientists is strongly encouraged (and it should not end at the level of undergraduate service teaching), as these may be an invaluable source of important research problems, and could justify an increase of resources. The Center has secured an impressive level of funding, but it is not clear what percentage of (European) network awards are reverted to this research group.

The Center is engaged in a very vigorous (PhD) training program. It is recommended that young trainees be strongly encouraged to go abroad during (at least part of) their PhD or postdoctoral training period.

The Leader of the Center has a clear vision of the state of the art in the field and of its leading scientists. He generates enthusiasm among his team, and he is urged to profit from this momentum to induce his team to get closer to applications. The presentation was lively and quite open (the reviewers could choose from flexible menus of topics and had ample time for discussion; members of the Unit were well prepared to answer all questions). The concern for quality is high, and the publication production is excellent, notably in the best journals of the field (JSL, TCS). However, the team should also consider submitting their research results to prestigious conferences such as LICS, which are well attended and provide a wide forum across all fields of logic for scientists interested in Computer Science Applications. Another good forum is the Logic track at the ESSLLI Summer School, where about 500 scientists from various areas of Logic, Linguistics and Informatics meet yearly.