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Preface

ICARIS 2006 is the fifth instance of a series of conferences dedicated to the comprehension and the exploitation of immunological principles through their translation into computational terms. All scientific disciplines carrying a name that begins with "artificial" (followed by "life," "reality," "intelligence" or "immune system") are similarly suffering from a very ambiguous identity. Their axis of research tries to stabilize an on-going identity somewhere in the crossroad of engineering (building useful artifacts), natural sciences (biology or psychology—improving the comprehension and prediction of natural phenomena) and theoretical computer sciences (developing and mastering the algorithmic world). Accordingly and depending on which of these perspectives receives more support, they attempt at attracting different kinds of scientists and at stimulating different kinds of scientific attitudes. For many years and in the previous ICARIS conferences, it was clearly the "engineering" perspective that was the most represented and prevailed through the publications. Indeed, since the origin of engineering and technology, nature has offered a reserve of inexhaustible inspirations which have stimulated the development of useful artifacts for man. Biology has led to the development of new computer tools, such as genetic algorithms, Boolean and neural networks, robots learning by experience, cellular machines and others that create a new vision of IT for the engineer: parallel, flexible and autonomous. In this type of informatics, complex problems are tackled with the aid of simple mechanisms, but infinitely iterated in time and space. In this type of informatics, the engineer must resign to partly losing control if he wishes to obtain something useful. The computer finds the solutions by brute force trial and error, while the engineer concentrates on observing and indicating the most promising directions for research.

Fifteen years ago, two groups of researchers (one from France at the instigation of Varela and the other from the USA at the instigation of Perelson) simultaneously bet that, like genetics or the brain, the immune system could also unleash a stream of computational developments grounded on its mechanisms. The first group was more inspired by the endogenous network-based regulatory aspects of the system. Like ecosystems or autocatalytic networks, the immune system is composed of a connected set of cellular actors whose concentration varies in time according to the interactions with other members of the network as well as through environmental impacts. This network shows an additional plasticity since it is subject to structural perturbations through the appearance and disappearance of these members. The most logical engineering inspiration lay in the realm of distributed and very adaptive control together with parallel optimization. The resulting controllers should keep a large degree

of autonomy, an important emancipation with respect to the designer, a potentiality slowly revealed through their interaction with the world and an identity not predetermined but constantly in the making.

The second group concentrated all its attention on the way the immune system treats and reacts to its exogenous impacts. It insisted in seeing the immune system, first of all, as a pattern recognition or classifier system, able to separate and to distinguish the bad from the good stimuli just on the basis of exogenous criteria and a limited presentation of these stimuli. It successfully stimulated the mainstream of engineering applications influenced by immunology: new methods of "pattern recognition," "clustering" and "classification". This vision of immunology was definitely the most prevalent among immunologists and certainly the easiest to engineer and to render operational. Whether or not this line of development offers interesting advantages as compared to more classical techniques, less grounded in biology, the future will tell. However, some members of this still modest community realized more and more that the time had come to turn back to real immunology in order to assess these current lines of research and to reflect on the possibility of new inspirations coming from novel or so-far neglected immunological facts: network, homeostasis, danger, are words appearing more and more frequently in the recent papers. Only a re-centering on theoretical immunology and a shift from the engineering to the "modelling" perspective could allow this turning point. This is how we saw this year's ICARIS, as the right time to question the engineering avenues taken so far and to examine how well they really fit the way theoretical immunologists globally construe what they study on a daily basis.

To consecrate this re-focusing, the organizers decided to invite four prestigious theoretical immunologists to present and debate their views, first among themselves but equally with the ICARIS community: Melvin Cohn, Irun Cohen, Zvi Grossman, Antonio Coutinho. Additionally, they decided to place more emphasis on the modeling approaches and favored in this conference proceedings papers with a more "biological" than "engineering" flavor. Sixty papers were submitted among which 34 were accepted and included in the proceedings. More than for the previous ICARIS, the first half of the papers are about modeling enterprises and the other half about engineering applications. We would like to thank the members of the Program Committee who did the right job on their fine selection of the papers and Jon Timmis for his very kind and precious collaboration.

June 2006 Hugues Bersini and Jorge Carneiro

Organization

ICARIS 2006 was organized by the IRIDIA laboratory of Universite Libre de Bruxelles and by the Instituto Gulbenkian de Ciencia.

Executive Committee

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