Abstract

This doctoral dissertation deals with methods to capture the interaction between humans and the technology they use to support their decision-making. Specifically, we are interested in such interactions within the domain of information fusion (IF). Traditionally, IF research tends to have a technological focus and view the user as a more or less passive receiver of information, somewhat detached from the fusion process, rather than an active contributor to it. Hence, the relationship between IF technology and its human users (who typically rely on technology in decision making) remains poorly understood.

The fundamental research question addressed in this doctoral dissertation is the following: How can the interaction between human decision makers and artefacts in semi-automated fusion processes (designed to support decision making) be captured? We first review existing methodologies that may be relevant for the present work. However, we find that none of them are able to capture such interactions in sufficient detail. In the present thesis, we therefore present a new methodology, specifically designed for capturing the characteristics of the interaction within existing semi-automated fusion processes, named CASADEMA (CApturing Semi-Automated DEcision MAking). CASADEMA is designed to be used by human-factors (or similar) researchers working within the domain of information fusion. More specifically, CASADEMA is designed to capture the interaction between the different components of the fusion process using a distributed-cognition perspective. The use of this particular theoretical framework from cognitive science enables the methodology to take into account not only the role of the data captured in the physical and digital artefacts of the fusion system (e.g., information from a fax or database, a piece of paper with a list of attributes, radar readings, etc.), but also the cognitive support function of the artefacts themselves (e.g., as an external memory) as part of the fusion process. To facilitate the use of CASADEMA, step-by-step instructions are provided in this thesis. Further, a standardised notation and definition of concepts have been designed to ensure the repeatability of studies using CASADEMA as well as consistency between them.

This doctoral dissertation describes in detail the design and development of CASADEMA, which has taken place over several iterations of theoretical and empirical cases studies. This style of development has ensured that the methodology was used in practical applications from an early stage onwards and could quickly be adapted to address specific issues that were encountered. More specifically, the dissertation presents two case studies which have informed the structure of CASADEMA as well as a final case study illustrating the application of the resulting product.

This doctoral dissertation thus contributes to the research in two main fields. Firstly, it enables, through CASADEMA, a distributed-cognition perspective on fusion processes in the otherwise rather technology-oriented field of IF research. This has important conceptual implications as it views fusion processes as extending beyond the boundary of physical/computer systems, to include humans, technology, tools as well as the interactions between them. It is argued that a better understanding of these interactions can lead to a better design of fusion processes, making CASADEMA an important contribution to the IF field. Secondly, the thesis provides, again in the form of CASADEMA, a practical application of the distributed-cognition theoretical framework. Importantly, the notations and definitions introduced in CASADEMA formalise otherwise currently rather loosely defined concepts and approaches in distributed-cognition research. Hence, the work presented here also contributes to the fields of cognitive science and human-computer interaction.