

Visual Specification of Spatial/Temporal Queries for Information Support of a Common Operational Picture

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Extended Abstract

Modern query languages will in many cases be concerned with a large variety of heterogeneous data sources, of which most will correspond to different sensors and where the input data, in particular, may be of spatial/temporal type. This requires not only structures for analysis, manipulation, data fusion and storage of such data but also methods for specification of the queries as well as visualization of the query result. Spatial/temporal queries become especially complex since they have to deal with multiple dimensions. For this reason, means to support inexperienced end-users in defining spatial/temporal queries must be developed. In this work, a visual method for the specification of this type of queries is proposed for an environment where the input data sources basically are sensors of various types and where the output is intended for visualization in a COP as a part of a command and control system.

Modern query systems require capabilities to automatically *select* sensors and algorithms for sensor data analysis without any user interference. The situation is complicated further because the selection of the sensor data analysis algorithms depends on aspects like weather and light conditions at the time when data are registered. Hence, it is necessary to design the query system so that the users do not need to have any deeper technical competence. Systems with these capabilities are said to be *sensor data independent* [1] since queries can be applied independently of which sensors and which algorithms that are actually used. The motivation for the introduction of this concept is that query system designed to handle multiple sensor data must be simple to use. That is, a high technical competence in using these complex information systems should not be required. Sensor data independence can from a practical viewpoint be carried out by means of an ontology combined with an ontological knowledge base [2], [3].

Sensors attached to information systems generate large quantities of heterogeneous data. In these data facts can be found that generally are redundant with respect to the problem to be solved. Furthermore, the data are often associated with various types of uncertainties due to limitations in the sensors. For this reason, a tool that can help separate the redundant information and fuse the relevant information is needed. However, such tools need to be general and efficient with respect to the variety of problems that may occur and that may require different combinations of information. For this reason the query language must include built-in support not just for sensor data independency but also for *sensor data fusion* [4] as well. Efforts must also be made towards the design of *usable systems* [5]. The latter is of great importance since most users will place a higher trust, or confidence, in the system at the same time as they will be able to concentrate their efforts on their primary tasks. In this work, the efforts towards the design of a usable user interface for a query language based on a visual language approach will be introduced. The query language, primarily designed for heterogeneous sensor data, is called Σ QL. In particular, in this work a visual user interface for the application of user-defined queries is introduced; a preliminary study of this approach was given in [6]. A more thorough description of Σ QL can be found in [7], [8].

The acquired query results are an important aspect when designing systems for command and control applications, and where sensors are the primary input data sources. In connection to this the users should be able to define relevant application oriented goals [9]. This will enable the system to acquire the information needed for the solutions of the problem at hand. Consequently, a system of this type must be *goal driven* or, as the case is here, *query driven*.

Data returned by the query processor must eventually be presented to the end-users in suitable way. Since we here are dealing with data of spatial/temporal type the natural way to do this must be to visualize them in a common operational picture that is part of the command and control system. More specifically, since the returned data in most cases can be associated with a geographical location this can be done directly within the context of the target, e.g. a map or in a natural synthetic environment. In Σ QL the queries are divided into two main categories where the first category concerns determination of targets of interest; the second concerns basically determination of spatial/temporal target relations by means of sets of functions. Targets determined from the first category are simply visualized in their context or in tables depending on the users' requirements. The second category returns results that require other, often more abstract, means for visualization, such as combinations of context and relational graphs.

References

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