"A FRAMEWORK FOR VISUAL MOTION UNDERSTANDING"

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Abstract

This paper discusses research into a general framework for understanding complex, predictable motions by computer. The objects to which the methodology may apply are those whose motion classes are definable, such as human gait patterns or heart wall motion. The main thrusts of the research are to find suitable representations for motion descriptions at different levels of abstraction and appropriate control structure strategies for using these levels of description for recognition. A formalism known as MDF (Motion Description Formalism) has been defined with which a domain expert can create a knowledge base of motion concepts which apply to his particular problem domain. This knowledge base can then be used by the system to classify motions exhibited by objects in the image sequence presented to it. The levels of description begin at the pixel level and proceed to shape transformations, directionals and adverbials, motion verbs for single, indivisible objects, motion verbs for aggregate objects, and motion verbs which require several participants. These concepts are organized along the IS-A and PART-OF hierarchies and are declaratively represented using frames. Frames may have similarity links to other frames which relate contexts of recognition. In addition, activation, deletion, progress toward instantiation and instantiation of individual frames may add support to or remove support from other competing or complementary frames. Similarity links are described procedurally using predicates defined in MDF and are associated with individual frames. The IS-A relations between frames also apply for these links.

The control structure relies heavily on the concept of co-operation and competition among local processes both at the image and description levels. Continuous relaxation, modified by prediction windows and by certainties which are provided by high levels of the system, is used for edge detection of the objects of interest. The outlines obtained, along with associated descriptors, are known as the essential traces of the image. From these, data on motion detection and correlation between pairs of images is determined. These data are known as the essential kineses of the objects. The essential traces and kineses are used by the recognition algorithms in order to determine more specific motion descriptions. Motion frames are activated by using precondition matching, IS-A and similarity information. Each frame contains expected motion characteristics for the class which they define. Therefore, during the course of recognition, predictions for expected object location and outline can be made which the low level uses as guidance. Hypotheses are added to those under consideration via IS-A, PART-OF and similarity links, while pruning of hypotheses is accomplished using matching failures and competition and co-operation among conceptually adjacent hypotheses.

The methodology is being tested with the implementation of ALVEN - A Left Ventricular Wall Motion Analysis Computer Consultant. The project is briefly described and preliminary results are presented.

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