A Discrete Event Framework for Intelligent Inspection

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Abstract

We address the problem of intelligent inspection in this work. In particular, we use discrete event dynamic systems (DEDS) to guide the sensing of mechanical parts for industrial inspection.

1 Introduction

The purpose of this work is to establish a method for solving a class of inspection problems in an intelligent way. We use an agent to sense the environment and to feed the relevant data to a control module that makes design and sensing strategy choices which affect inspection activities. The autonomous sensing system can be modeled efficiently within a DEDS framework. DEDS are dynamic systems in which the use of discrete control events ensure stability and observability [2]. It is possible to *control* and *observe* hybrid systems (systems that involve continuous, discrete and symbolic parameters) under uncertainty using DEDS formulations [1,2,3]. The DEDS model is used as a structuring technique to utilize the known information about the way mechanical parts should be explored.

2 Methodology for Inspection

We use a B/W CCD camera and a coordinate measuring machine (CMM) probe with the necessary interface to a Sun Sparcstation as the sensing machines. The part is inspected by the cooperation of the observer camera and the CMM probe; a DEDS is used as the high-level structuring framework for exploring the mechanical part. The sequence of visual events occurring in the system should be observed in order to determine the state of the exploration process. A decision is then made to assert the current state of the observer DEDS automaton. In inspection activities, the DEDS guides the probe to the features where discrepancies occur between the machine part (or a CAD model of it) and the recovered depth/structure data points. The computed structure data from the observer agent are then used to drive the CAD module. Two and three-dimensional visual cues are used to estimate the current inspection state [4]. Examples include: depth from stereo and contours, segmentation data, and boundary information.

3 Current Developments

The environment we eventually intend to design consists of three major parts: the sensing, design, and manufacturing modules (for reverse engineering applications.) The goal is to establish a computational model that is capable of recovering the structure of machine parts, inspecting and refining them, thus, allowing the creation of a flexible engineering environment that is extensible. The control flow will be from the sensing agent to the design module and then to the manufacturing module. Feedback is then re-supplied to the sensing agent in order to inspect manufactured parts, compare them to the original ones, and continue the loop until a certain tolerance is achieved. The system is intended to be as autonomous as possible. We intend to study what parts of the system can be implemented in hardware. Providing language interfaces between the different components in the inspection and/or reverse engineering control loop is to be addressed, too.

References

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