



A BRIEF REVIEW OF FIXTURE DESIGN AND AUTOMATION

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Abstract: *The problem of fixture design, as one of the pivotal elements which significantly influence the quality of process planning in manufacturing engineering, remains topical, especially in a highly automated, flexible manufacturing environments. Computer-aided fixture design has, for a number of years now been in the focus of a large number of researchers. The results of this research have allowed a systematized knowledge of the possibilities offered by computer-aided fixture design. Emphasized in this paper is the importance of automation in fixture design. Characteristic approaches to fixture design automation are reviewed and analyzed. Basic features, advantages and disadvantages of particular approaches are examined. The paper concludes with future directions of research.*

Key words: *fixture, design, automation, CAFD*

1. INTRODUCTION

During the last couple of decades the computers have been increasingly used to assist design activities. The beginnings of their application date back to the sixties of the last century, when they were first successfully used to control machine tools. This was followed by an expansion of their application in various domains of manufacturing engineering. The concepts of flexible manufacturing system (FMS) and computer aided manufacturing (CIM) have evolved since. Today, the emphasis is placed on the intelligent manufacturing systems which are able to solve problems without the use of an explicit and detailed algorithm or a mathematical interpretation of the problem. Various CAX (Computer Aided Everything) systems are used to assist product design and manufacture in order to shorten the time and related costs. Numerous systems have been developed which allow automation at particular stages of design and manufacture. Computer technologies have revolutionized modern manufacturing. From the

standalone CAD/CAM applications, to PDM/ERP (Product Data Management/Enterprise Resource Planning) systems, the computer technologies have fulfilled the dreams of every manufacturer – shorter product development time, higher quality, and lower costs. Computer-aided fixture design (CAFD) has become reality as part of this revolution by integrating the fixture design know-how and CAD platforms. With the aim to reduce fixturing costs, over the years, various CAFD systems have been developed to assist fixture designers. Although numerous research efforts have been aimed at development of fixture design systems, there is still a need for development of a method which would assist the designer at fixture elements level, where the basic task would be to identify the required structure of fixture i.e. the optimal number and arrangement of elements according to predefined criteria. Though the primary function of a fixture is allow precise location and clamping of workpiece, there are a lot of other criteria to be satisfied, which most often pertain to ergonomic issues. Finally, one of the most important aspects of fixtures is their impact on manufacturing costs through assembly time, materials, costs of fixture manufacture, etc. Another interesting feature of fixture design is the fact that the various requirements to be met are usually opposed to one another. Fixture design and manufacture costs can account for up to 10-20% of the total manufacturing costs [30]. These costs not only pertain to fixture material, manufacture and assembly, but also encompass the costs of fixture design. Lowering of fixture design costs induces significant economic effects. There are two approaches to this goal. One is focused on the development of flexible fixtures, while the other relies on the simplification of fixture design through computer application.

2. GENERAL CHARACTERISTICS OF SYSTEMS FOR AUTOMATED FIXTURE DESIGN

Computer-aided fixture design is a more recent way of design (the first attempts at fixture design automation date back to the eighties of the last century). This approach evolved as an attempt to overcome the negative aspects of the conventional design paradigm.

CAFD uses computer to automate the steps in fixture design. The goal is to generate an adequate fixture solution within an acceptable time frame, while at the same time minimizing the subjective influence and effort of the designer. The most important assumptions for efficient application of computers in the process of fixture design are the 'translation' of designer's knowledge and experience into a computer-usable form, the development of a logic used in selection and decision-making, etc [27]. In essence, the systems for automated design are based on information technologies (IT), while their structure and principle of functioning make them specialized IT systems. Regardless of methodology applied in the development of a system for automated fixture design, the constituent parts of every system are: module for defining of input information, module for generation of output information, and a data base [28].

