

# Automated process planning for the manufacture of sliders

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## Abstract

This paper presents a methodology of a computer-aided process planning system for an injection mould component, slider, which will facilitate the standardisation of process planning and significantly reduce lead-time. A combination of generative and variant approach is used for the development of the system. The input to the system is a 3D slider model. Firstly, the system classifies the slider types and extracts the feature parameters from the model. Each slider type refers to a standard process plan template, in which a set of processes in sequence is presented. Secondly, the system selects machines, cutters, fixtures and cutting parameters for each process in the plan template based on the actual dimensions of features and the available machining resources. The process plan execution is then simulated on the screen step by step. Although the system is developed for sliders, the approach is generic in nature and could be easily extended to include other mould components, such as lifters, mouldbases, etc. © 2000 Elsevier Science B.V. All rights reserved.

*Keywords:* CAPP; Injection mould; Slider; Feature

## 1. Introduction

Process planning is a systematic determination of the detailed methods by which parts can be manufactured from raw material to a finished product. It is an important stage linking design and manufacturing in an industrial organisation. In general, it includes material selection, process selection, machine tool selection, tool selection, sequence of operation, fixture selection, process plan documentation and so on. As process planning is a very complex job, a computer needs to be used if the task is to be accomplished within a feasible period of time. On the other hand, optimal process plans do not usually remain static but change with changing conditions, such as lot sizes, availability of equipment, and any emerging new

technology. It is, therefore, a major advantage of computer-aided process planning (CAPP) that it accounts for any variation in the manufacturing parameters. It has been recognised that CAPP bridges the gap between engineering design and manufacturing and forms a key factor in integrating the activities in a manufacturing organisation [1].

With the rapid development of computer-aided techniques in the last two decades, many CAPP systems have been developed and reported [2]. These developed CAPP systems are based on variant approach or generative approach. In the variant approach, a new process plan is produced by retrieving the plan for a similar part and manually modifying the plan to fit the part at hand; but in the generative approach the system uses the knowledge about the manufacturing processes to create the process plan from scratch. Some variant systems include AUTOP-LAN [3], AUTOCAP [4], and generative systems

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include KAPLAN [5], QTC [6], GENPLAN [7], and TVCAPP [8]. The presence of difficulties with a purely generative system resulted in some researchers proposing a semi-generative approach to CAPP, which is basically a combination of the variant and generative methods. The aim of such system is to reduce user interaction by incorporating standard operation sequences, heuristic, rules and mathematical formulae to the system [9]; COMPLAN [10] is such a system.

In spite of enormous efforts, reported CAPP systems still lack industrial acceptance. The researchers have restricted their problem domains to handle only certain aspects. Some considered only rotational parts while others concentrated on prismatic ones only, thus incorporating a very limited number of manufacturing features. Furthermore, currently there are no CAPP systems for mould manufacturing and it leads to motivate this research.

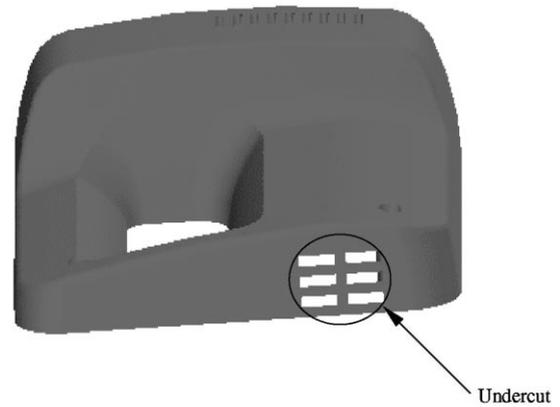
This paper presents a CAPP for the manufacture of sliders. A combination of variant and generative approach is used for the development of the system. The input to the system is a 3D slider model. Firstly, the system classifies the slider types and extracts the feature parameters from the model. Each slider type refers to a standard process plan template, in which a set of processes in sequence is presented. Secondly, the system selects machines, cutters, fixtures and cutting parameters for each process in the plan template based on the actual dimensions of features and the available machining resources. The process plan execution is then simulated on the screen step by step. The tests demonstrated that such an approach is very close to the current industrial practice and has high adaptability.

## 2. Injection mould and slider

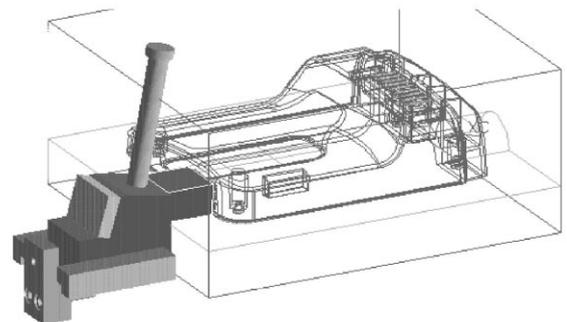
Injection mould is the heart of injection moulding which is an indispensable process in the manufacturing of plastic components. Timing is critical for any mould making company wishing to have the leading edge in today's world market. Many manufacturing companies are willing to pay high premium for a shorter delivery lead-time of a mould. To achieve this, one approach is to shorten the processing time by using automated CAPP; another approach is to reduce the mould design lead-time [11]. For the latter, intel-

ligent 3D injection mould design software, IMOLD [12] has shown to shorten the design lead-time significantly. To further reduce the manufacturing lead-time, an automated CAPP system is necessary.

A slider is one of the most important components of a mould. It is used to form an undercut in a mould. A slider is normally mounted at a right angle to the mould drawing direction for forming a recess or protrusion in the side face of a moulding in the position of undercut. Fig. 1(a) shows an external undercut of a part and Fig. 1(b) shows the slider assembly for the undercut in the mould. Fig. 2 shows the different components of a slider assembly. Generally, a slider assembly consists of slider body, slider head, wear plate, guide, heel block, angle pin and stop



(a) A part with an undercut



(b) A slider assembly for the undercut

Fig. 1. A slider in a mould.

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