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## COMPUTER NUMERICAL CONTROL SIMULATION TOOL FOR TEACHING AND LEARNING OF ENGINEERING STUDENTS

**Abstract:** This article develops a new educational simulation tool whose goal is to enable the practical teaching and learning of CNC machines. The idea is based on the possibility that the simulator could be driven and controlled by a conventional 3-Axis Computer Numerical Control machine tool (CNC). The paper describes the development procedure of a simulator, the selection of a corresponding mechanisms and the programming algorithm.

**Keywords:** CNC simulator, development procedure, mechanism

### 1. INTRODUCTION

Computer numerical control (CNC) tooling is considered one of the core elements of precision manufacturing in engineering education. In fact, CNC tooling becomes a major part of machinery instruction and training programs at most vocational schools and vocational training units. For students to learn to program CNC is important because they can use CNC programming techniques to write workpiece tooling programs, which forms the basis of computer aided-design and – manufacturing (CAD/CAM) technology education. Nevertheless, due to the high cost of equipments, unavailability of sufficient equipments, and damage to equipments resulting from improper use, learners lack enough hands-on experiences, therefore optimal learning results may not be achieved.

Simulation is usually used to resolve the aforementioned problem. As for computer-aided learning, researchers have reached a consensus that auxiliary software simulation tools can enhance students' learning effectiveness. Simulation allows learners to actively

participate in learning [1]. Simulation is considered to be the most effective and efficient method of teaching and studying complex and dynamic systems thus can save time and yield even better learning results than other methods [2]. Furthermore, in terms of teaching and learning in numerical processing technology, CNC code implementation results, debugging, supplementary writing, and cutting tool cutter path simulation can not only help instructors teach effectively but also enhance learners' technical skills and learning interest by shortening their learning time. Based on the recent ubiquity of the Internet and development of relevant technologies, research on CNC program instructional simulation systems has achieved some valuable progress. For instance, Huang et al. [3] developed an Internet-based integrated manufacturing laboratory as a supplement to instruction in different manufacturing modules. Cheng [4] used the CORBA (common object request broker architecture) to construct a distance CNC program instructional simulation system. Furthermore, Hutchinson and Kuester [5], and Ong and Mannan [6] applied virtual reality (VR)









