

DESIGN OF PORTABLE 3-AXIS FILAMENT WINDING MACHINE WITH INEXPENSIVE CONTROL SYSTEM

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Abstract

Filament winding technology is one of the fundamental methods in composite material fields, which needs a high degree of automation. It is the process in which continuous strands or filament of fibres are wound on the mandrel, which is more suitable for making high-pressure vessels, pipes, shaft and ducts. The filament winding machines have existed in enterprises or factories, which are high costs, heavy, complex control system, simple products so far. This paper describes the development of a new 3-axis filament winding machine for the production of wound composite cylinders, which is designed to be more portable, lightweight, low costs, high efficiency and easy control system compared to previous machines. It relates to design hardware control system and the software control system. Based on three axes movement principles, a 3-axis prototype filament winding machine has been developed. The x-axis is the movement left and right of the carriage, the y-axis is the rotation of mandrel and the z-axis is the movement of the feeder. Arduino Uno and CNC (Computer Numerical Control) shield module are used as hardware of control system. Universal G-Code Sender (UGS) and Grbl (G-codes) are adopted as software control system. In conclusion, a portable 3-axis filament winding machine has been successfully designed and performed, which offers potential filament wound composite cylinders with simple control system.

Keywords: 3-axis filament winding machine, Arduino Uno, UGS, Grbl

1. INTRODUCTION

Filament winding process is an expanding composite manufacturing technology, the introduction of advanced lightweight mass production items has increased the performance requirements of this manufacturing process[1]. Fibre reinforced composite materials have widely used in various industries, from relatively simple civil applications[2]. To satisfy the technology requirements, many composite material companies have improved the performance on cost-effective, high-grade quality, recyclable products. In short, the composite material has excellent corrosion resistance, good resistance to temperature extremes and wears[3]. Composite materials have been generally used in many fields including aerospace, chemical, automotive, civil engineering, military, motorsports and offshore industries[4].