Construction of a Customized Inkjet 3D Printer for Ceramic Fabrication

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Abstract

In this work, we use an open-source design to create a customized 3D inkjet printer for ceramic 3D printing. The preliminary results of the design and fabrication of the printer system are presented. In the ongoing research, experimentation with the inkjet printer head will be performed to evaluate the printer's performance with different optimized powder and binder recipes. The focus will be on understanding the effectiveness of this promising manufacturing technique.

Keywords: Inkjet 3D Printer, Open-source Design; Additive Manufacturing

1. Introduction

Inkjet 3D printer offers the advantages of a higher resolution printing compared to the extrusion-based printer which satisfies the ceramics and electronics application requirements [1]. Additionally, there is minimal support needed when compared with other methods of rapid prototyping thus reducing the material and operational costs due to its commercial availability [2]. Its capabilities permit operability with specific polymers, composites, ceramics, and other custom materials [3]. The disadvantage of binder jetting technology is that it requires constant cleaning around the printhead and is potentially hazardous to one's health if the powdered material is not properly contained [4].

In this work, the goal is to develop a powder-based 3D printer utilizing an inkjet printer head that allows users to fabricate 3D ceramic components. The printing process applies layers of powder alternatively with an ink cartridge binder to form the desired model. At the same time, the heating element will heat up the powder bed allowing the binding process to occur. The printer follows the design of the 3DP 3D Printer (Plan B) offered by a Dutch engineer, Yvo De Haas. The detailed project instructions and list of materials are available online on the YTEC website [1]. Special modifications are made to meet our specific hardware and software requirements.

2. Method

2.1 Binder jetting technology

This method is commonly referred to as a granular-based technique where a laser beam or binding agent is applied repeatedly to form a fabricated layer on a powdered bed as shown in Figure 1. The platform will lower each time a new layer is added on top of the material until the model is completed. The printed layer does not need any support because each powdered layer keeps the model intact. During the printing process, the entire powdered bed will be heated, causing the binder and powder to bind together properly. This process is more efficient and faster compared