MANUFACTURING & AUTOMATION RESEARCH CENTER

KOÇ UNIVERSITY

Development of a New Open Architecture Rapid Prototyping System

Supported by

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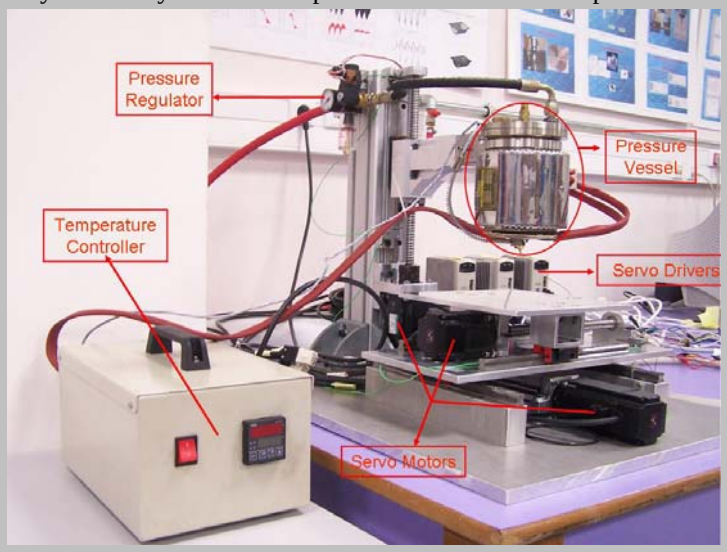
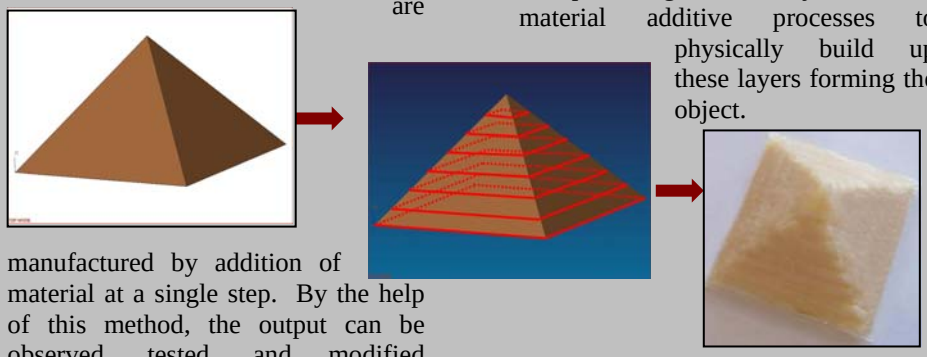
Motivation:

To date, most of the manufacturing is accomplished by coarse shaping processes like casting, forging, etc., which is followed by a fine tuning operation, called metal finishing such as turning, milling, drilling, and many more. It is not possible to see the characteristics and properties of the outcome before overgoing all these operations, which makes the whole process substantially expensive, considering the outcome, may not satisfy needs of the product.



To overcome this problem, a new method called "rapid prototyping" is introduced. Unlike the operations described above that use subtraction of material at each step to conclude a product, rapid prototypes are



manufactured by addition of material at a single step. By the help of this method, the output can be observed, tested, and modified accordingly with a relatively very low cost. The goal of this project is, therefore, to produce a rapid prototyping machine that works with the highest precision, smallest tolerances, and least operation time possible.

Research:

This project includes design and manufacturing of a rapid prototyping machine using fused deposition modeling (FDM). Throughout the project, the rapid prototyping machine was designed in a virtual environment; and static and modal analyses were performed in order to ensure the stability of the machine. Following the design process, the study includes the machining of the structural parts with a computer-numerical-control (CNC) machine, the development of an algorithm to transfer any computer-aided-design (CAD) data to a real-time controller, and experiments on a number of thermoplastic materials to be used while building the prototype output.

Solid freeform fabrication (SFF) process performed in this project is based upon a layered manufacturing paradigm. In this method, a solid 3D CAD model of the object is first decomposed into cross-sectional layer representations in the process planner. The planner generates trajectories for material additive processes to physically build up these layers forming the object.

The last phase of the project includes the design of a nozzle. A specific thermoplastic will be fused in a pressure vessel and deposited to form a 3D prototype product. After a number of experiments, the material will be specified according to its viscosity and the time required to cure.