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CALTRANS DIVISION OF RESEARCH, INNOVATION AND SYSTEM INFORMATION

TRANSFORMING IDEAS INTO SOLUTIONS

Research Notes

Commercial Metal 3D Printers and their Utility in Caltrans Operations

Evaluation of metal 3D printing systems to make informed decisions on integrating metal 3D printing technology into Caltrans Vehicle maintenance operations.

Equipment

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Project Title: Commercial Metal 3D Printers and their Utility in Caltrans Operations

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WHAT IS THE NEED?

The California Department of Transportation (Caltrans) needs to maintain and repair their equipment such as vehicles or machines and their infrastructure. Caltrans sometimes faces challenges in efficiently managing repairs and fabricating parts for diverse infrastructure needs, especially in emergency or remote situations. Traditional manufacturing and procurement processes can be time-consuming and costly, often leading to delays in critical maintenance activities.

Caltrans needs to work within an evolving landscape of infrastructure maintenance and therefore should evaluate the potential of cutting-edge technologies like metal 3D printing. Given the diversity of California's infrastructure and the frequency of situations requiring immediate response, such as post-disaster repairs, the adaptability and efficiency of metal 3D printing can be highly beneficial.

WHAT ARE WE DOING?

This research will investigate the benefits and challenges in using Commercial Off-The-Shelf (COTS) metal 3D printers in Caltrans maintenance operations. It aims to understand how metal 3D printers can streamline the production of custom parts and facilitate rapid on-site repairs to potentially reduce costs and downtime. Commercial systems will be compared in a market study with regard to number of part variants, batch size, print frequency, materials, dimensions, concerns around safety, powder handling, heat treatment, and costs (investment and operation). At least one metal 3D printer will be acquired by Caltrans, and the researchers will support its use in a maintenance shop (field testing). The research team will collect user feedback and explore new opportunities for part design with 3D printing, relevant to Caltrans operations. In test prints, the quality of printed parts will be evaluated with

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surface quality and dimension measurements. The final product will be a comprehensive evaluation, based on market studies and field testing, to support Caltrans in deciding on and adopting metal 3D printing technologies in Caltrans' specific maintenance needs.

WHAT IS OUR GOAL?

This research will serve as a guide for Caltrans to make informed decisions on integrating metal 3D printing technology into vehicle maintenance operations.

WHAT IS THE BENEFIT?

Metal 3D printing allows for on-demand production of parts, reducing the need for extensive inventories and long lead times associated with traditional manufacturing processes. This technology enables the fabrication of custom parts tailored to specific maintenance needs, particularly beneficial for older infrastructure where replacement parts may no longer be available. In emergency situations, such as post-natural disaster repairs, metal 3D printers can rapidly produce necessary parts on-site, significantly reducing repair times and enhancing responsiveness.

WHAT IS THE PROGRESS TO DATE?

The research team visited the Caltrans HQ shop and conducted footprint measurements, took pictures of the ventilation system and sample parts, and documented the assembly process of snowplow vehicles at the Caltrans shop. The team confirmed that the available Caltrans space is suitable to accommodate potential procurement of the metal 3D printer. The research team collected responses from shop managers on their 3D printing needs and presented to the project panel a basic comparison of different printing systems.