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CONSTANT CHAMBER ILLUMINATION OF 3D PRINTING PRINTZONE

HP INC

Constant chamber illumination of 3D printing printzone.

Abstract

In-process monitoring within 3D printing systems is desirable. There is often a source of light which is necessary for the 3D printing process. This is often an intermittent illumination. In-process monitoring systems require constant light conditions. This disclosure concerns active control of LEDs placed within the process chamber to achieve a constant light condition.

Publication

Within 3D printing devices, in-process visual monitoring by eye is desirable to detect real-time issues. This is common for both R&D units as well as units deployed at customer sites. Some 3D printers may use light radiation as a critical part of the process, such as IR lamps or lasers. This necessitates a window that strongly filters light emitted to outside of the printer for safety of personnel near the printer. Therefore, windows are strongly tinted with filters to prevent harm to personnel working with the printer.

The process light radiation is not normally illuminated for 100% of the printing time. When it is in use, it is normally enough to illuminate the inside of the printer, even with the strongly tinted window, so that an operator can easily inspect the inside of the chamber. When the process light source is not in use then the operator is not able to see anything of the inside of the chamber through the strongly tinted window. Inspection at this time is therefore not possible.

To solve this problem, an extra source of illumination, in this case LEDs, is added to the inside of the process chamber so that it is always illuminated and visible through the tinted window. This system provides the sufficient illumination required to enable remote system monitoring with webcams for general fault detection, layer quality monitorization, stereovision system and other desirable components to add to the printer.

To enable constant lighting functionality necessitates active control of the LEDs to compensate for the intermittent process illumination. The current illumination state of the chamber maybe acquired by extrapolating from the power of each source of light or even using a light sensor. In the current invention disclose we propose a solution to enable a constant, or desired, light level during the build process that compensate the cycles of the process light source.

The LEDs are chosen as the secondary and controlled light source as they have a very low effect on part temperature, but a high effect on optical light level control. An algorithm can modulate the secondary light source to keep constant the total lighting in the print chamber, compensating for changes in illumination due to process light sources. Several methods can exist to keep the chamber lighting constant. For example: machine learning algorithms to predict and set the secondary light source power; a servo over the PWMLED; or using an illumination to PWM table. This is an example of the last methodology:

To ensure constant illumination we need to map the PWM of the LED and process illumination source to the $IL_{CHAMBER}$. Where IL is the ILlumination. We can define

Secondary lamp power = PWM_{LED}
Process illumination source power = PWM_{HEAT}
Then we need to obtain the
IL_{BED} as f(PWM_{HEAT})
IL_{BED} as f(PWM_{LED})

To obtain these values we increase sequentially the PWM while measuring the illumination. During the build process the PWM_{HEAT} is determined by the bed temperature algorithm so the secondary light power is chosen by:

PWM_{LED} = f (IL_{BED}(Target) - IL_{BED} as f(PWM_{HEAT})) -1

With the explained algorithm, we will be able to:

- Illuminate the build area for in-process monitoring, without affecting the process.

- Enable image capture at any time of the process without compromising the process requirements.

- Improve usability, by removing the requirement to open the print cover to know what happens inside the printer.

Disclosed by Rhys Mansell, Sergi Puigardeu and Sergi Culubret, HP Inc.