Novel US patents on the 3D – print.

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Abstract: 3D – printing is the quickly expending area of modern industry. In this review is carrying review of novel US patents on this topics.
Keywords: 3D - printing; application in civil & military engineering; application in industry and medicine.

2023 was yet another year of change and growth for the additive manufacturing industry — and 2024 promises to be just as exciting. So, what can you expect? Read up on the four trends we expect to have the biggest impact in the year to come.

At the end of every year, we reflect on our industry. What has changed in the last twelve months? And what will we see in the year to come? Normally, the answer is the same:

"The industry continues to grow."

This year is a little different. The adoption of 3D printing isn't just increasing. It's shifting. We see shifting approaches. Shifting mindsets. Shifting markets. And even shifting limitations. These are the trends we expect to have the biggest impact in 2024:

• 3D printing: two distinct paths to adoption

We can see two clearly defined — and co-existing — approaches to how companies adopt 3D printing.

• The rise of 3D printing's 'middle class': mid-range machines for the mid-range market

Traditionally, 3D printing offered two options: low-budget or a top-end machine. This left a large customer segment whose needs weren't being met — until now.

• Shifting mindsets: from "Why?" to "How?"

Companies are now well aware of the benefits of 3D printing — they no longer ask why they should use it. Now, they're asking how they can integrate the technology and scale up production.

• Mass manufacturing meets 3D printing: will dream become reality?

Inspiring innovations in markets such as China, the US, and Germany are beginning to make 3D printing's costs as desirable as its benefits. Will we see it become a viable mass-manufacturing technology?

It's clear that 3D printing has a bright future and will continue to develop in the months to come. These trends are a clear sign of how the industry is maturing and shifting to meet the ever-changing needs of manufacturers. The global 3D printing market surged towards a size of $98.31 billion in 2023, accompanied by a remarkable compounded annual growth rate of 18.92% from 2023 to 2032, the stage is set for a wave of innovation and advancements within the industry.

In 2024, the spotlight will shine on the integration of advanced materials, with a particular emphasis on sustainability, more personalization, and the integration of 5G.

As we approach 2024, the 3D printing landscape is on the brink of remarkable transformations, urging manufacturers to embrace these trends to stay ahead in an increasingly competitive market. Explore our predicted 2024 trends for a comprehensive outlook.

We can expect to see a surge in advanced materials being developed and used in 2024, especially when it comes to making strides toward sustainability. Mass customization is poised to reach new heights in 2024, thanks to advancements in 3D printing technologies. Manufacturers will increasingly leverage the power of additive manufacturing to produce personalized products at scale, catering to individual customer preferences. This trend is expected to disrupt the industry by offering businesses a competitive edge in delivering tailor-made

solutions. From biodegradable polymers to high-performance alloys, the materials used in additive manufacturing will become more diverse, allowing for the creation of intricate and durable structures. This trend aligns with the growing demand for customized, application-specific products across various industries.

The integration of 5G technology with 3D printing processes will streamline production workflows in 2024. Faster data transfer and reduced latency will enable real-time monitoring and control of 3D printing operations, enhancing efficiency and minimizing errors. This convergence of 5G and additive manufacturing will be particularly crucial for industries that require rapid prototyping and on-demand production. In 2024, the industry will witness a heightened emphasis on sustainable practices, with an increased use of eco-friendly materials and energy-efficient printing processes. Manufacturers adopting greener 3D printing solutions will not only contribute to environmental preservation but also align with the rising demand for sustainable products. As we embark on the journey into 2024, the 3D printing landscape is poised for remarkable transformations. Embracing these trends will be crucial for manufacturers looking to stay ahead in an increasingly competitive market.

Injection molding, an essential in manufacturing, excels in mass-producing plastic parts with precision and cost-effectiveness. Yet, the rise of industrial 3D printing introduces a transformative shift, challenging traditional methods with its tool-less process and design versatility, especially in 3D printing for production and creating 3D printing injection molds. This synergy between injection molding and 3D printing in manufacturing marks a new frontier, blending established efficiency with innovative flexibility.

These trends are illustrated the novel US patents on the 3D – print:

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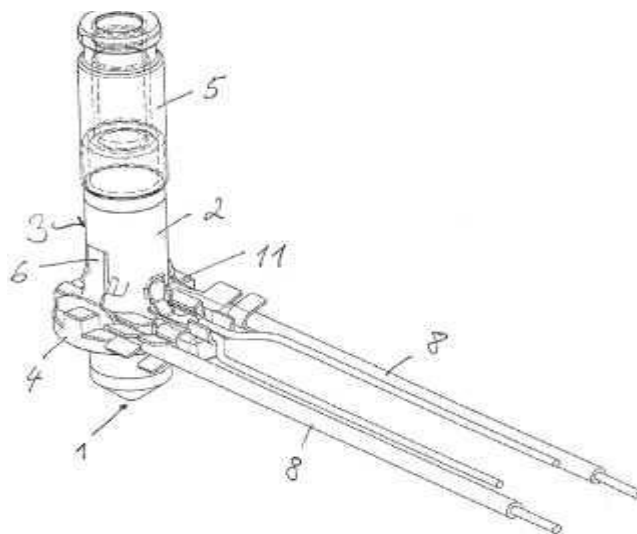
A print head for a 3D printer includes a nozzle for dispensing molten material. A pipe is connected to the nozzle and carrying a heating resistor layer. The pipe is seated in an annular bracket. Spring contacts are mounted on the bracket, which contacts bear against the pipe at mutually opposite points and contact the heating resistor layer.

US2024126233 (A1) [1]

A process for manufacturing a rigid aquatic floating object including an elongate three-dimensional external profile having in total a main length extending from its nose to its tail, a thickness, a width, a deck and an underside. The process includes a) digitally modelling the floating object to be manufactured, b) producing a hollow and apertured internal skeleton by additive manufacturing/3D printing of a multitude of plastic wires that are locally connected to one another geometrically and that reproduce a three-dimensional mesh obtained in a), c) placing the result under vacuum and bonding at least one composite sheet made of fibre and resin around the skeleton forming a shell, d) applying successive fibre-and-resin layers so as to reinforce, via stratification, the shell of step c), and e) finishing the external surface of the stratified sheets made of fibre-and-resin composite by sanding to obtain the final shape of the floating object.

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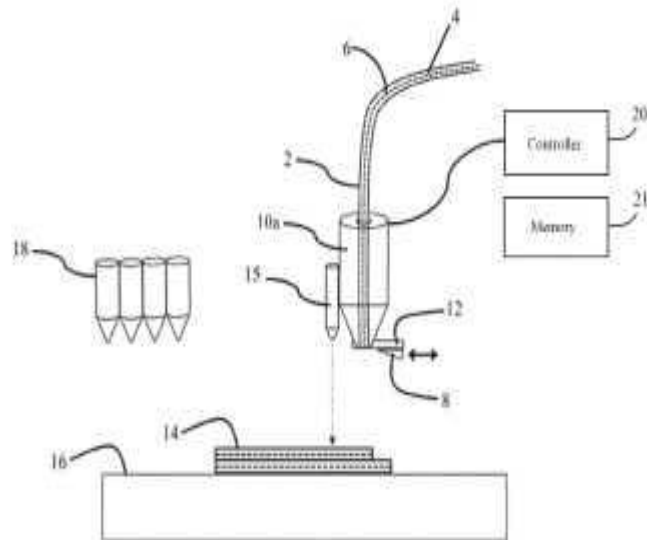
A 3D printing apparatus and method that compensates for offset in the deposition of print material as a result of nozzle movement. The compensation may include discretizing a path of travel of a 3D print nozzle into segments, compensating each path segment based on an expected offset of print material deposition, and generating a compensated path of travel. The compensation may apply an inversion of a system model that is based on an expected offset of print material deposition relative to the nozzle path of travel.

US2024189912 (A1) [2].

The present disclosure provides three-dimensional (3D) printing systems, apparatuses, methods and non-transitory computer readable media for the production of at least one requested 3D object. The 3D printer described herein facilitates operation of a layer dispensing mechanism with high precision albeit operating in an enclosure contaminated by debris, e.g., during the 3D printing. The debris may be a byproduct of the 3D printing.

US2024165883 (A1)
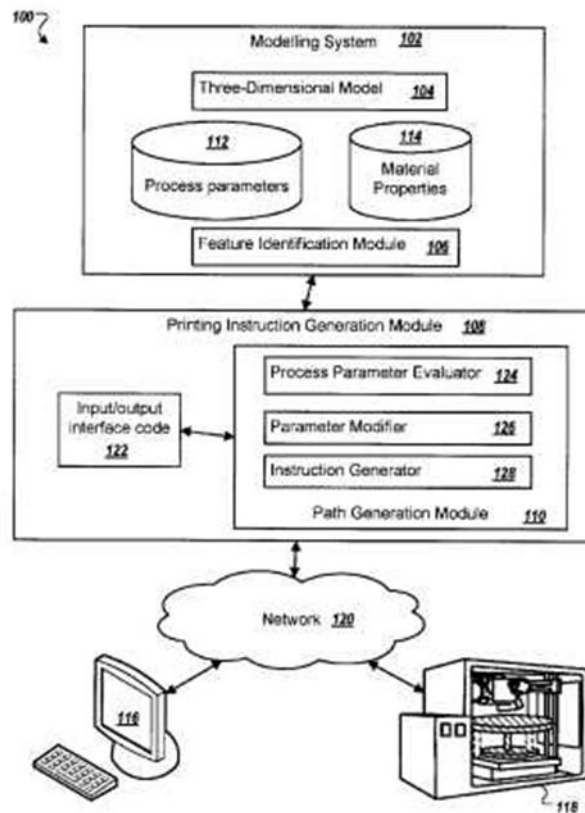
Methods, systems, and apparatus, including computer programs encoded on computer storage media, for providing instructions for printing of 3D objects. One of the methods includes obtaining i) information regarding one or more geometric features of a 3D model of an object to be printed by an extrusion-based 3D printer and ii) process parameters for use in printing; generating, by the computer-aided manufacturing environment, print instructions for the printing of the 3D object by the extrusion-based 3D printer in a series of multiple layers, wherein modified process parameters are generated as part of the print instructions by modifying the obtained process parameters for a proper subset of layers based on the information regarding the one or more geometric features of the 3D model of the object; and providing, by the computer-aided manufacturing environment, the print instructions comprising the modified process parameters to operate the extrusion-based 3D printer to print the object.

US2024189 [3].

A 3D printing system includes an ejector configured to receive a build material. The ejector includes a nozzle. The ejector is configured to eject a plurality of drops of the build material through the nozzle. The 3D printing system also includes a substrate positioned below the nozzle. The drops fall toward the substrate after being ejected from the nozzle. The drops form a 3D object on the substrate. The 3D printing system also includes a power source configured to generate an alternating electrical current. The 3D printing system also includes an electrode configured to generate a plasma in response to receiving the alternating electrical current. The drops, the 3D object, the substrate, or a combination thereof are positioned at least partially within the plasma.
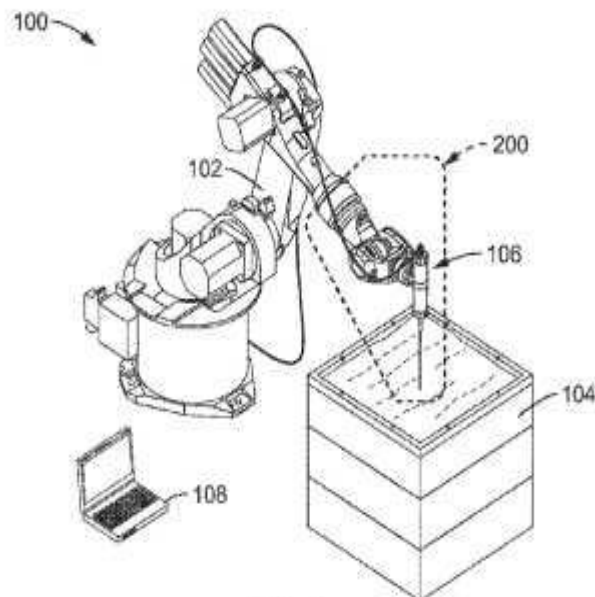
WO2024102803 (A1)

FIG. 1

Non-planar Granular 3D Printing (NGP) is a process wherein a liquid binder is selectively injected into a loose granular particle volume of materials using a

pneumatic liquid dispenser. In contrast to other three-dimensional (3D) printing processes that can fabricate objects in sequential layers, NGP allows for non-planar toolpaths that can travel in multiple axes simultaneously, spatially depositing the liquid binder within the particle volume to rapidly construct complex 3D printed objects without the need to 3D print temporary supporting structures.

US2024190075 (A1) [4].

A 3D printing system in which paste is used to fill a space enclosed by a 3D printed mold wall, uses a blade for spreading the paste. A cleaning system for the blade includes an immersion bath, which is filled with fluid to a fluid level. Rotating brushes are partly submerged in the fluid, and when cleaning is needed, the blade is located between the brushes. The brushes rotate onto the knife such that each surface of the knife is brushed over to remove debris from the paste into the fluid.

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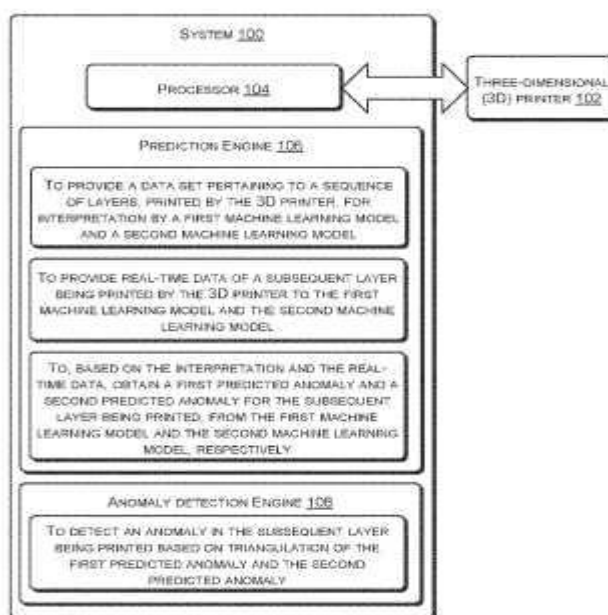
Examples of systems for triangulation-based detection of anomaly in a print job performed by a three-dimensional printer are described herein. In an example, a data pertaining to a set of layers printed based on the print job of the 3D printer may be provided to two models to obtain respective predicted anomalies. Thereafter, the obtained predicted anomalies may be triangulated to detect an anomaly in the layer being printed by the 3D printer.

US2024190067 (A1) [5].

The invention relates a resin composition containing a polymer matting agent, that improves the aesthetic appearance of an article formed by Material Extrusion 3D printing. The composition contains 30-99.9 wt % thermoplastic resin and 0.1-50 wt % of one or more spherical or near-spherical polymeric matting agents (PMAs) such as Altuglas Acryperl® beads from Arkema. Objects 3D printed from the composition have hidden layer lines (a.k.a. "build lines") and is more uniform in appearance, compared to an object printed from the same thermoplastic resin without PMAs.

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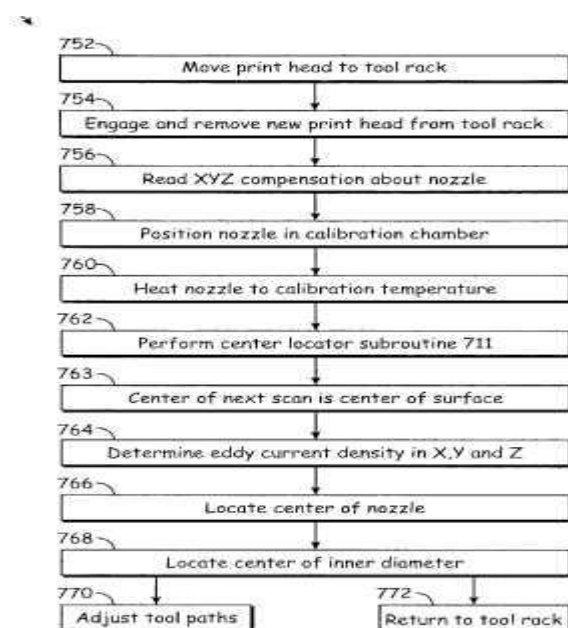
A method for calibrating a 3D printer includes the steps of providing information obtained in a factory calibration indicating a center of an inner diameter of a tip orifice in a metal extrusion nozzle and a center of a tip surface for the nozzle and inductively sensing the nozzle with an eddy current sensor when secured to a print head on a gantry or robotic arm of the 3D printer to identify a sensed location of the center of the tip surface of the nozzle. The method includes determining a location of the center of the inner diameter of the tip orifice on the nozzle on the print head and utilizing the provided information to locate the center of the inner diameter of the tip orifice.

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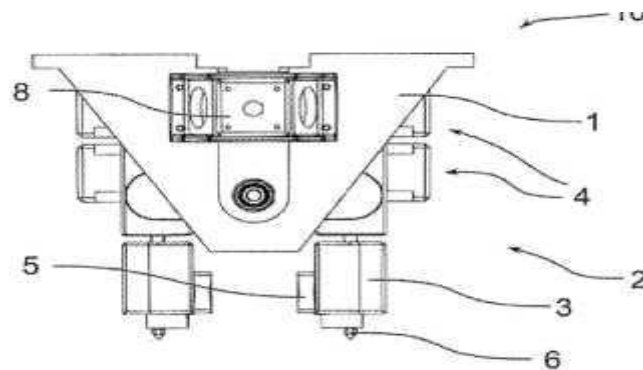
A 3D printer printing head assembly comprises a printing head carrier and a printing head, which comprises at least two printing units implemented such that they are mutually offset in the print plane. Each printing unit comprises an extruder, filament feeder, cooling mechanism, and nozzle. The printing units at a mutual spacing are adapted for simultaneous printing in different, mutually offset print planes. This assembly therefore allows for printing in multiple planes simultaneously. Furthermore, the object of the invention is a 3D printer with this assembly.

US2024190040 (A1) [6].

The present invention discloses a slurry feedstock for extrusion-based three-dimensional, 3D, printing of a functionally graded article, and/or for casting an article under a low pressure at a room temperature, a method of preparing the same, a method of extrusion-based 3D printing and/or casting, and a system therefor. The slurry feedstock comprises a build material comprising a metal, a ceramic or any combinations thereof, an organic polymer binder, an additive and a volatile organic solvent. The build material mixed with the additive and the organic polymer binder dissolved with the volatile organic solvent form a first pre-mix and a second pre-mix, respectively, that are mixed to form a substantially homogeneous and flowable slurry mixture that is used for producing articles.

US2024190066 (A1) [7].

A device and method for printing 3D articles including electronic and functional elements including 3D printer and a plasma jet printer based on a dielectric barrier atmospheric pressure plasma jet system in which both printing and in-situ treatment and post-deposition treatment can be carried out to tailor the materials characteristics. Plasma jet printer comprising of electrodes in the nozzle/print head for applying electric field and generating atmospheric plasma that could be used for non-gravity based highly directional printing in any direction. Integration of dielectric barrier plasma printer and plasma treatment jets with the 3D printer increases the capability of embedding high performance electronics in a 3D printed structure aiding in additive manufacturing of functional devices. Ability to use a range of materials for print head assembly including micro machined silicon increases the resolution of the plasma jet printer to sub-micron level.

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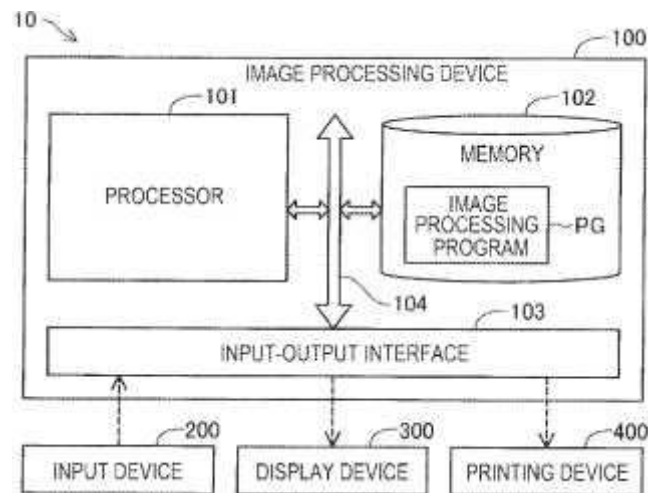
An image processing device includes: an image data acquisition unit that acquires image data; a print condition acquisition unit that acquires a print condition including a type of a print medium on which an image is printed; a parameter acquisition unit that acquires a texture parameter indicating a texture of the print medium; a color conversion unit that performs color conversion corresponding to the print condition, on the image data; and a rendering unit that executes rendering, causing the image data on which the color conversion is performed, to correspond to at least one of a front face and a back face of a 3D object representing a shape of the print medium, and causing the texture parameter to correspond to the front face and the back face of the 3D object, and thus generates a rendered image representing the print medium with the image printed thereon.

US2024190775 (A1) [8].

This disclosure provides resin formulations which may be used for 3D printing and thermally treating to produce a ceramic material. The disclosure provides direct, free-form 3D printing of a preceramic polymer, followed by converting the preceramic polymer to a 3D-printed ceramic composite with potentially complex 3D shapes. A wide variety of chemical compositions is disclosed, and several experimental examples are included to demonstrate

reduction to practice. For example, preceramic resin formulations may contain a carbosilane in which there is at least one functional group selected from vinyl, allyl, ethynyl, unsubstituted or substituted alkyl, ester group, amine, hydroxyl, vinyl ether, vinyl ester, glycidyl, glycidyl ether, vinyl glycidyl ether, vinyl amide, vinyl triazine, vinyl isocyanurate, acrylate, methacrylate, alkyl acrylate, alkyl methacrylate, phenyl, halide, thiol, cyano, cyanate, or thiocyanate. The resin formulations may contain a solid-phase filler, to provide high thermal stability and mechanical strength (e.g., fracture toughness) in the final ceramic material.

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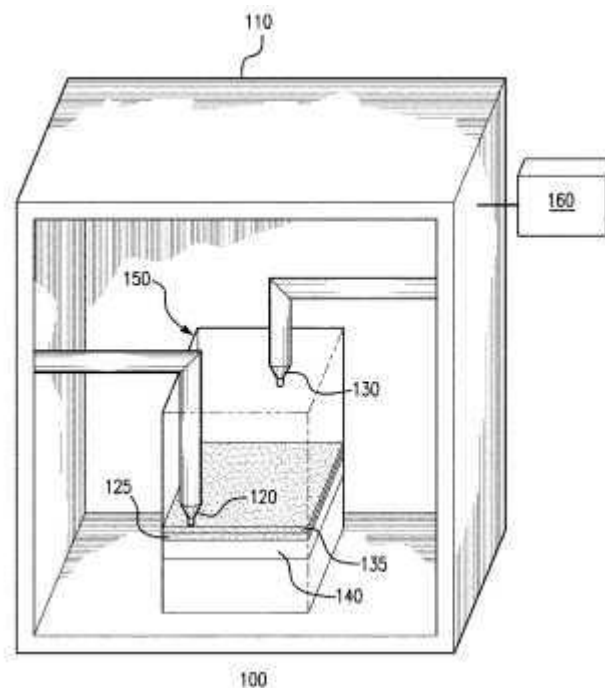
According to some embodiments, a system includes a three-dimensional (3D) printer, a hydraulic press, and a kiln. The three-dimensional printer includes a print bed, a first printhead, and a second printhead. The first printhead is configured to deposit a layer of a first powder on the print bed. The second printhead is configured to deposit a layer of a second powder on the print bed. The

hydraulic press is configured to compress a greenware to form a compressed greenware. The kiln is configured to heat the compressed greenware to a reaction temperature to form an object. The object is surrounded by an excess of the first powder. The kiln is also configured to heat the object surrounded by the excess of the first powder to a melting temperature. The melting temperature is at least the melting point of the first powder and less than the melting point of the object.

US2024182635 (A1) [9].

The invention relates to a process for preparing particles of polyphenylene sulfide polymer (PPS), based on the use of a polyester polymer (PE) comprising units from a dicarboxylic acid component and a diol component, wherein at least 2 mol. % of the diol component is a poly(alkylene glycol). The process comprises the melt-blending of the PPS with the PE, the cooling the blend and the recovery of the particles by dissolution of the PE into water. The present invention relates to PPS particles obtained therefrom and to the use of these particles in SLS 3D printing, coatings and toughening of thermoset resins.

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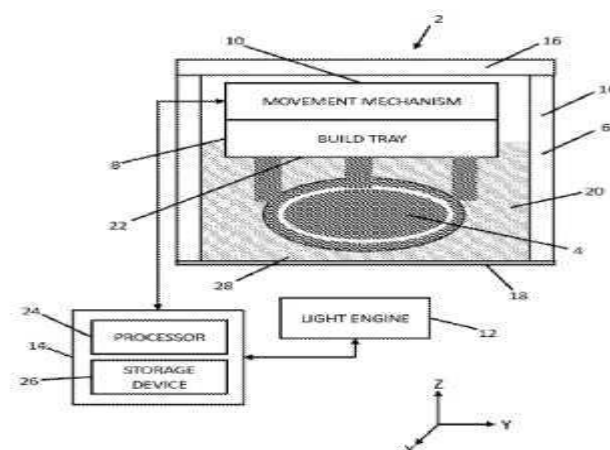
A method of manufacturing a three-dimensional (3D) article includes operating a print engine to fabricate a composite structure including the 3D article coupled to a support structure, removing the composite structure from the fluid

tank, and peeling the inside surface of the sheath away from the outer surface of the article, peeling progressively breaks the plurality of strands. The support structure includes a conformal sheath having an inside surface that follows the outer surface of the 3D article with a gap between the inside surface of the sheath and the outer surface of the article, and a plurality of strands that span the gap and individually have opposed ends that are coupled to the inside surface of the sheath and the outer surface of the article to maintain the gap, the gap filled with the photocurable liquid ink.

US2024139022 (A1)
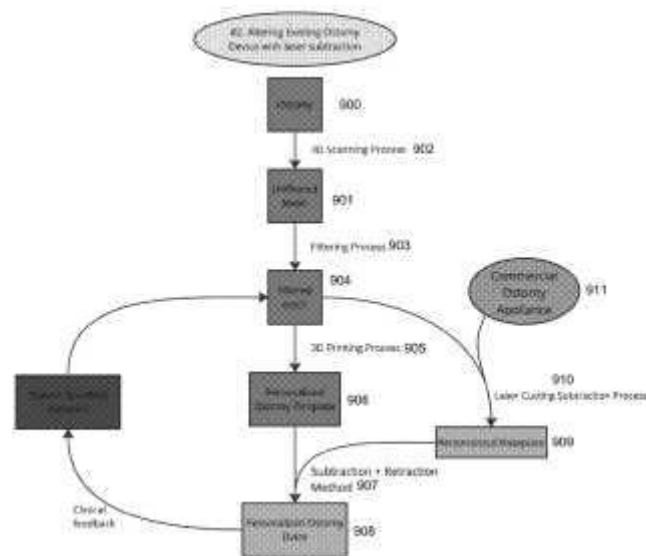
A personalized ostomy appliance, including a baseplate, leveraging three-dimensional ("3D") scanning, computer-aided design modeling, and 3D printing technology, to empower patients to improve quality of life and decrease ostomy complications. In embodiments, the process uses 3D scanning technology to create a raw peristomal mesh. In embodiments, this mesh is filtered using a smoothing and splicing algorithm with patient-specified preference variables. In embodiments, this personalized filtered mesh is then used in a subtractive manufacturing process, including applying a laser cutter or blade press, to alter an

ostomy baseplate. The personalized filtered mesh can also used to 3D print a personalized ostomy template that improves fit of the baseplate using a retraction method. This process can be applied to wound care with negative pressure vacuum therapy and fistula management systems wherein a vacuum or pouch baseplate is generated for improved fit and healing.

US2024180198 (A1) [10].

Described are 3D printing platforms comprising stereolithographic 3D printing devices utilizing a static optical assembly and procedural modeling applications representing 3D scenes as signed distance function. Described are also structures such as bioreactors that can be printed using such platforms, as well as characteristics and used thereof.

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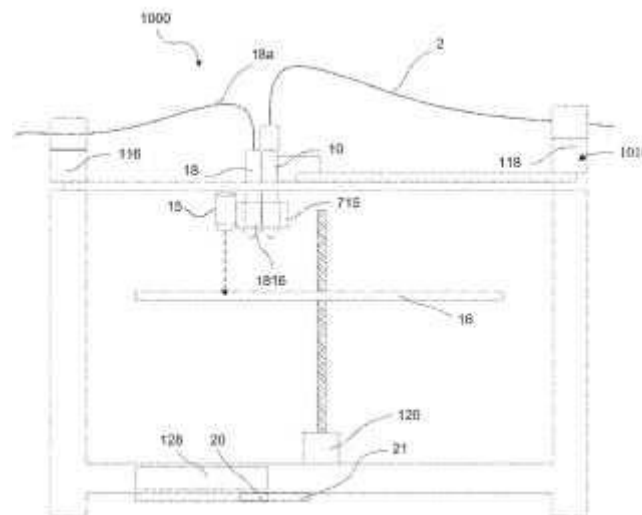
A 3D printing apparatus and method prints a partial part, and continues to print the part after the partially-printed part has been rotated. Each partial printing operation may include reinforcement via application of one or more layers of

continuous fiber. The rotation and continued printing of the partially-printed part allows for fiber orientation in different orientations for the printed part.

WO2024086372 (A1)
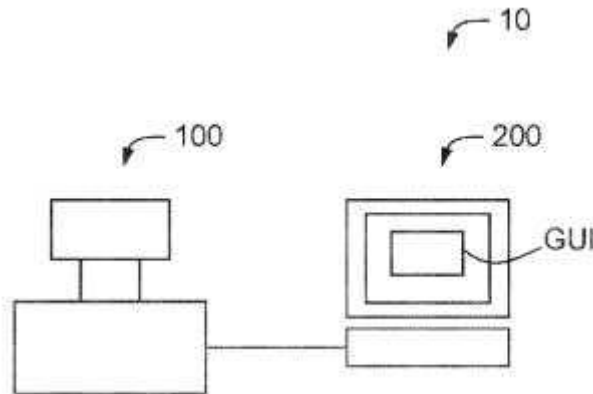
A system and method of adjusting a dental appliance by modifying a corresponding digital dental appliance model. The system includes an additive manufacturing system (e.g., a 3D printer system) and a controller running software. The system is designed to (i) 3D print a dental appliance using an initial digital dental appliance model, (ii) determine any portions of the printed dental appliance that may require modification, (iii) automatically adjust the appliance's digital model by performing pixel offsetting to implement a modification, and (iv) reprint the appliance using the modified digital model.
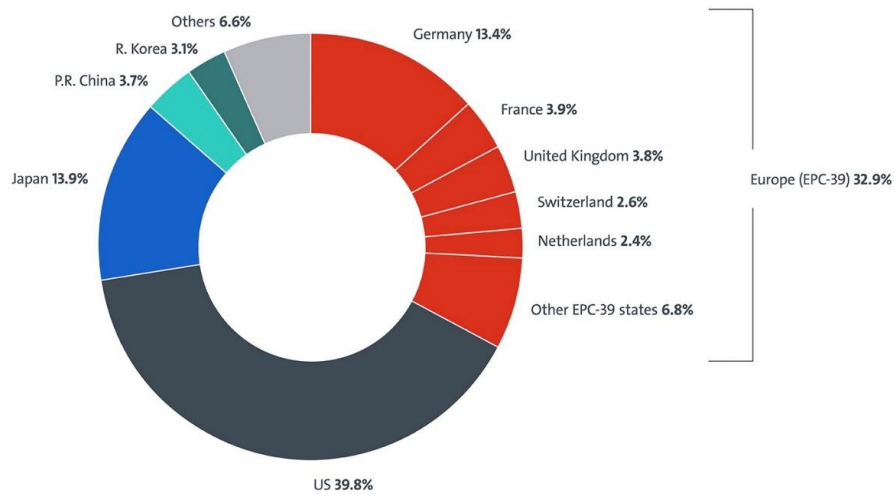
US2024131800 (A1)
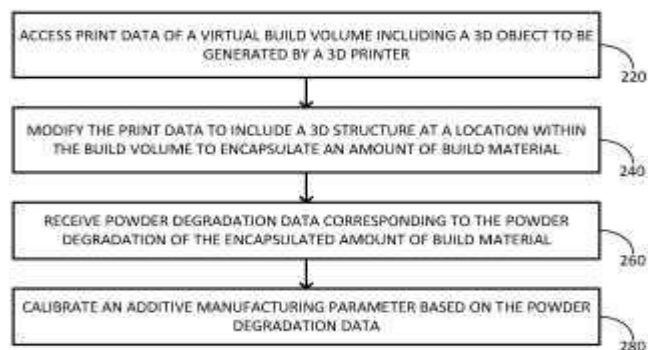
A computing device comprising a controller is disclosed herein. The controller is to access print data of a virtual build volume including a 3D object to be generated by a 3D printer; modify the print data to include a 3D structure at a location within the build volume to encapsulate an amount of build material; receive powder degradation data corresponding to the powder degradation of the encapsulated amount of build material; and calibrate an additive manufacturing parameter based on the powder degradation data.

US2024126233 (A1)

A system for layer-by-layer three-dimensional (3D) printing of a 3D printed object. The system includes a printing component configured to print a plurality of layers to form the 3D printed object, a surface modification component configured to be co-operable with the printing component and configured to apply an appropriate degree of surface roughness to at least one of the plurality of layers after being printed, and a controller configured to identify parameters of each of the at least one of the plurality of layers and configured to control operation of the printing component and the surface modification component, wherein the parameters include the appropriate degree of surface roughness.

In a landscape where innovation is the name of the game, 3D printing is stealing the spotlight. Once a niche technology, 3D printing is breaking traditional production barriers, cutting waste, and supporting mass customization across various industry sectors. A new report from the European Patent Office (EPO) strengthens this observation. Accounting for 40% of global patenting activity in additive manufacturing (AM), U.S. researchers and inventors are playing a significant role.

Countries of origin for international patent families in 3D printing technologies, 2001-2020

Others 6.6%
R. Korea 3.1%
P.R. China 3.7%
Japan 13.9%
US 39.8%
Germany 13.4%
France 3.9%
United Kingdom 3.8%
Switzerland 2.6%
Netherlands 2.4%
Other EPC-39 states 6.8%
Europe (EPC-39) 32.9%

Source: European Patent Office

Considering that 3D printing technology originated in the U.S. nearly four decades ago, it's not surprising to see the country continuing to lead in this transformative field. Titled "Innovation trends in additive manufacturing: Patents in 3D printing technologies," the study takes a deep dive into international patent data, offering a comprehensive global snapshot of the current state of 3D printing. According to the report, the U.S. and Europe are at the forefront of innovation in this area. Together, they account for nearly three-quarters of all 3D printing inventions worldwide, with the U.S. leading at 40% and Europe following closely at 33%.

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198A1&KC=A1