# Grooved nozzle

## Optimized combination nozzle for isotropic 3D printing

### Invention

Specifically printed connecting surfaces allow optimized cohesion for individual strands during additive material extrusion processes (fused deposition modeling, or FDM; fused filament fabrication, FFF; etc.), producing better-performing structures and components that are less anisotropic.

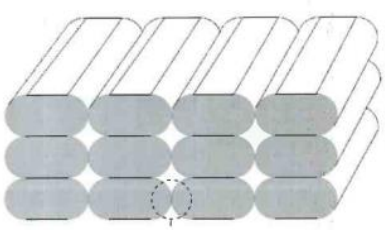

Fig. 1: State-of-the-art strand combination with large gaps

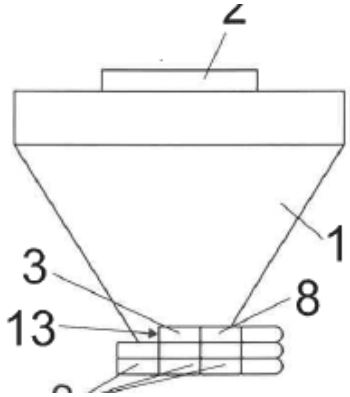


Fig. 2: New nozzle for creating rectangular connecting layers

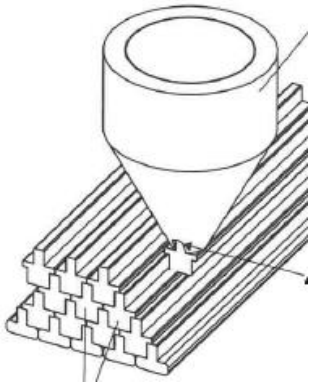

Fig. 3: Alternative design: new nozzle geometry with anchor system for conventional printing or alternating layers

Conventional nozzles with their round outlets and flat surfaces tend to produce oval strand cross-sections, which cause gaps in the structure and generate significant anisotropic component properties. Outlet openings can give the deformable strand (of polymer melt, for instance) any shape so that gapless connecting surfaces can be created in both horizontal and vertical orientations.

In addition to optimized geometry for changing vertical connection, a guide unit has been added to the system that presses the freshly extruded material onto the material next to or below it. This almost completely eliminates gaps between individual strands. The principle also allows printing with alternating layers (see Figure 3).

### Commercial Opportunities

Some of the new nozzle geometries can be retrofitted to all existing FDM/FFF printers, providing a simple, low-cost option for enhancing printed material stability in all layer orientations without post-processing (warming, etc.).

### Current Status

TU Dortmund University submitted a German patent application for the invention with the option of international expansion in May 2023.

Functional prototypes have been created and successfully tested.

An invention of the TU Dortmund University.

### Competitive Advantages

- More isotropic component properties from conventional extrusion printing
- Combines pressure and printing
- Can be retrofitted modularly
- Improved product properties
- Increased transparency
- Individually adaptable nozzle systems
- Near-to-net shaping
- Alternating layers

### Technology Readiness Level

1 2 3 **4** 5 6 7 8 9

Technology validated in lab

### Industries

- Plastics industry
- Automotive
- Aerospace
- 3D printing service

### Ref. No.

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