



Supporting Information

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Non-Planar Multiprocess Additive Manufacturing of Multifunctional Composites

*Jean-François Chauvette, Iee Lee Hia, Juliette Pierre, Gabriel Chenier, Rouhollah D. Farahani, Nicola Piccirelli and Daniel Therriault**

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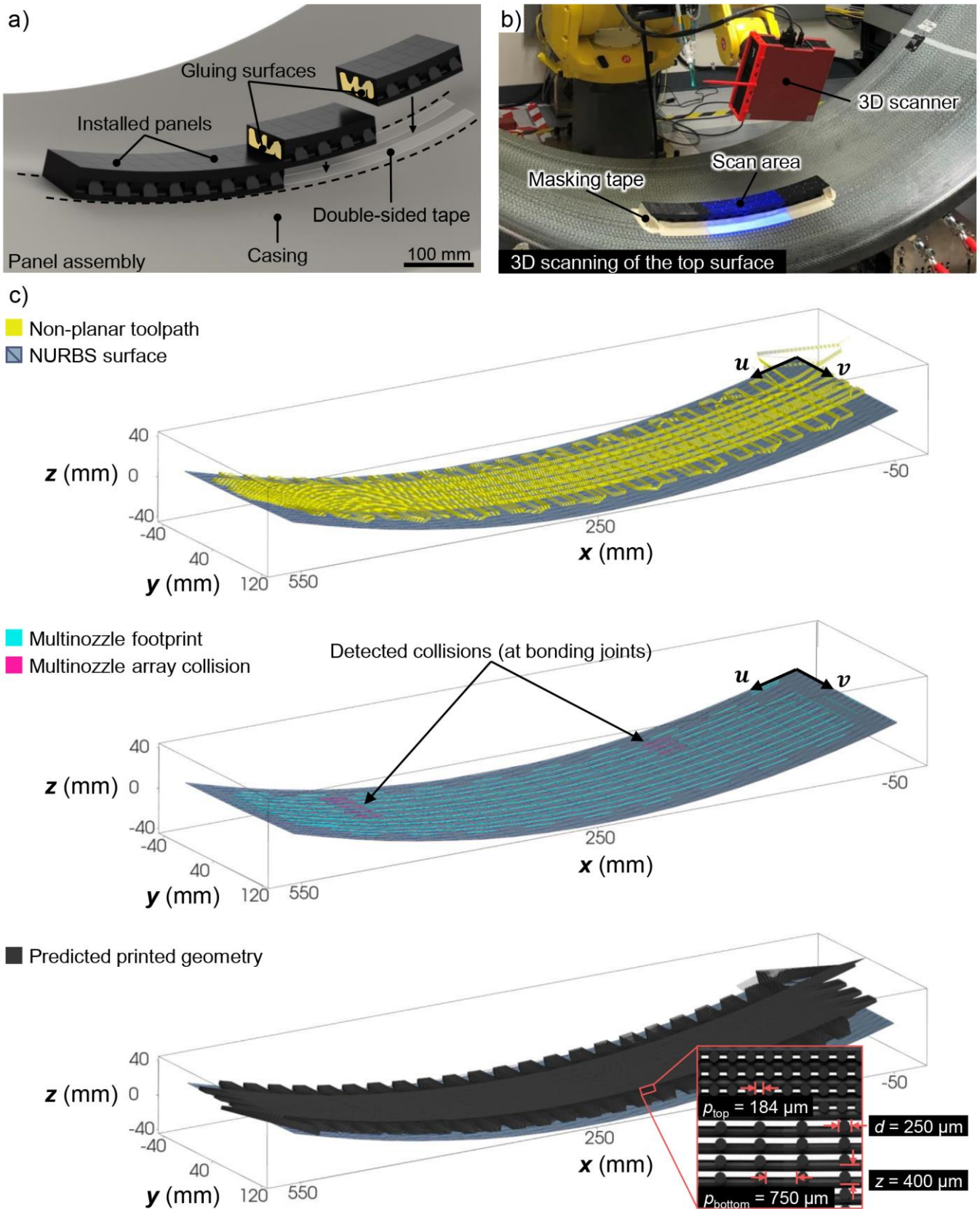


Figure S1. a) Sandwich panel assembly. The panels were glued together side-by-side using the epoxy resin Epon 862 and Epikure 3274 curing agent, and installed on the aircraft casing

using double-sided tape. b) Masking tape was installed on the side of the panel to protect it from material losses during the multinozzle AM process. The 3D scanner was used to obtain a mesh representation of the top surface of the panel. c) Multinozzle Toolpath Generator (MTG): the scanned surface of the sandwich panel was used to generate a NURBS surface composed of 50×11 control points (in the u and v directions, respectively), and second degree interpolation splines. The MTG generated a non-planar multinozzle AM toolpath on top of the NURBS surface and corrected some nozzle array collisions with the substrate (that appear to be located at the bonding joints of the panels, probably due to misalignment during assembly). Rotation matrices were calculated for all positions of the toolpath and sent to simulation software RoboDK to solve the inverse kinematic problem that allows the 6-axis robot to manufacture the printed geometry predicted by the MTG. The programmed micro scaffold geometry consists of filaments diameter $d = 250 \mu\text{m}$, same orientation layer height of $z = 400 \mu\text{m}$, bottom porosity level pore size $p = 750 \mu\text{m}$, and top porosity level pore size $p = 184 \mu\text{m}$.



Video S1. Non-planar multiprocess additive manufacturing of multifunctional composites (available at <https://youtu.be/rOM-yvUt5iw>).

S1. Comparison of commercial and modified 3D-printable abradable materials

Table S1 presents a comparison of the two abradable composite materials. The benchmark (Scotch-Weld EC-3524 B/A Black, 3M, France) is composed of two-part systems: an amine hardener (part A) and epoxy resin (part B). Both parts were already pre-loaded with ~ 22.5 wt% of GM intended to lower the material cured density to 0.505 g cm^{-3} . The 0GM12FS formulation (*i.e.*, addition of 0 wt% GM and 12 wt% FS) is based on the same epoxy resin and amine hardener as the benchmark, but without any GM, to avoid any risk of nozzle clogging and crushing of the GM, bringing its cured density to 1.279 g cm^{-3} .

Table S1. GM and FS loadings of abradable materials with the measured cured density.

Abradable material	Part A/ part B [wt%]	GM [wt%]	FS [wt%]	Cured density [g cm ⁻³]
Benchmark	77.5	22.5	0	0.505
0GM12FS formulation	88	0	12	1.279