3D Printing Maple Seeds as a Covert Surveillance Vehicle

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Introduction: Maple Seeds are a frequent sight outside, as their unique aerodynamic characteristics enable them to spread slowly and be taken far from their originating tree. These unique characteristics offer an opportunity to use the seeds as an aerial delivery vehicle for covert sensors. Their natural appearance conceal the sensor while their auto-rotating flight enables the payload to be delivered safely to the ground from a controlled aerial system.

3D Scanning

Bio-Inspired Design

CT scan of Wing

Cross Section of Wing

3D Model of Maple Seed

Real Maple Seeds were 3D scanned using a Micro-CT scanner to help us understand the density and wing shape characteristics that cause the Leading Edge Vortex that reduces the drag of the wing during flight.

Mass Density

sectioning

Center of mass at 0.0285 ± 0.040 L

Material Selection
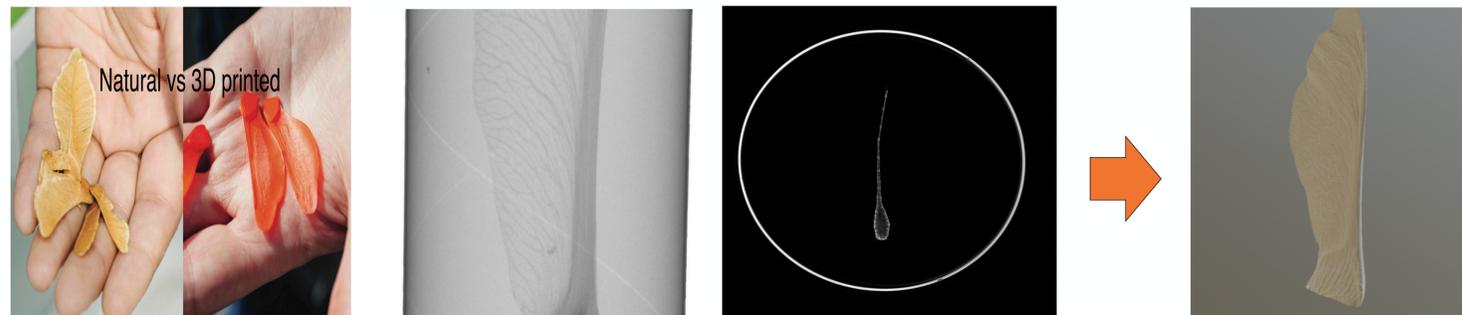
Material	Density (g/cm^3)	Stiffness (GPa)	Compatibility with PVA	Biodegradable	Max Service Temp °C
PLA	1.24	3.45	Good	Yes	49.7
ABS	1.11	1.79	Poor	No	68.9
PP	.90	1.18	Poor	No	107
Nylon	1.13	2.9	Fair	No	124

Results

Maple Seed	Center of Mass (% of span)	Avg Mass (g)	Avg Wing Loading	Avg Descent Velocity (m/s)	Velocity Error (%)
Real	28	.102	2.09	1.11	0
Bioinspired	23	.183	3.18	1.31	18
Biomimetic	28	.198	3.03	1.19	7.2
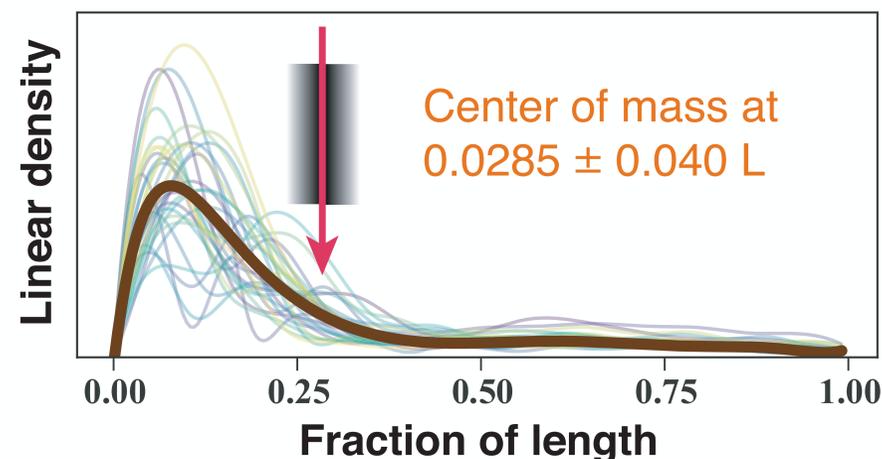
Left: A bioinspired maple seed (left) compared to a biomimetic maple seed (right). A more realistic looking seed that retains some of the critical characteristics for flight such as wing roughness and a slightly curved leading edge.
Right: A painted biomimetic maple seed that would contain a sensor in the seed pod, ready to be concealed operationally.