Description

Image

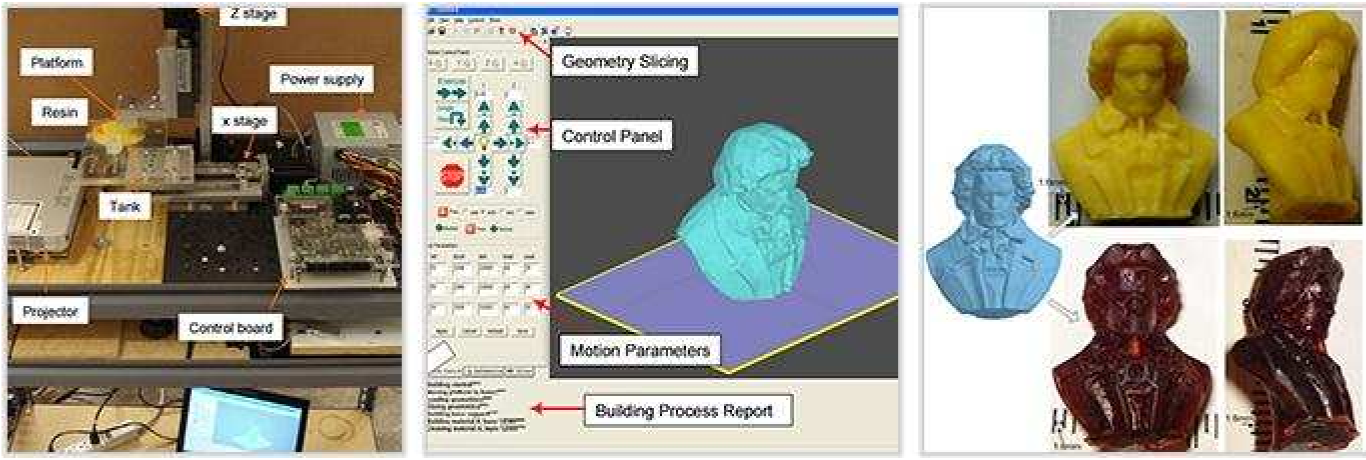


Image caption

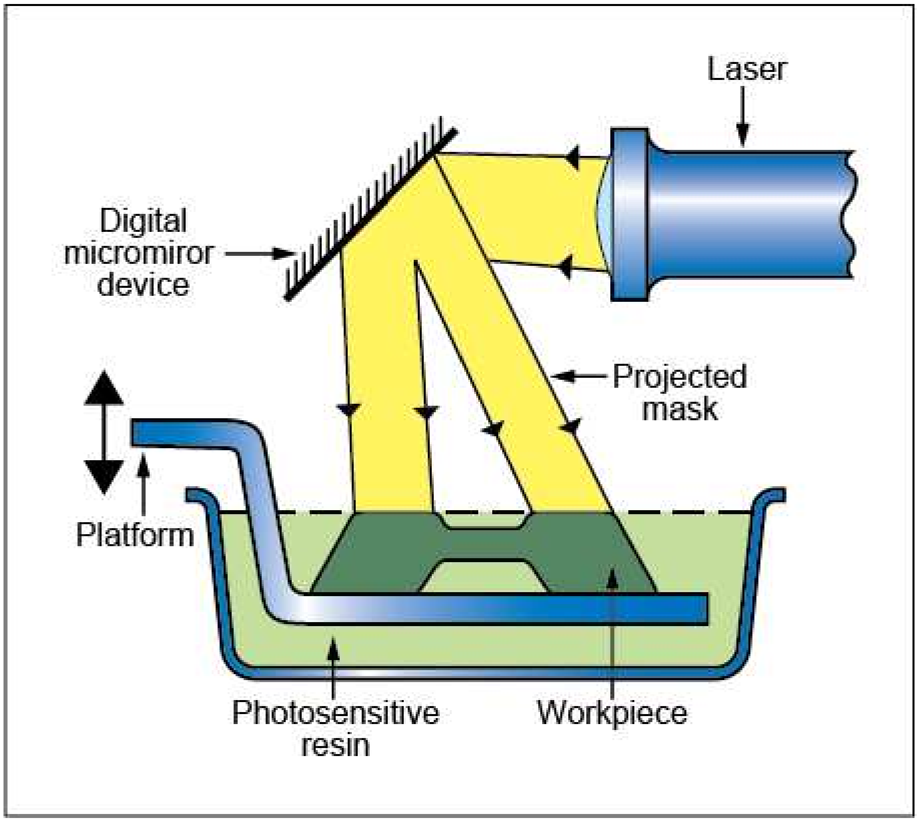
(1) The prototype hardware system for the fast MIP-SL process © Yong Chen (2) MIP-SL related software system © Yong Chen (3) CAD model and two views of the built objects in two liquid resins © Yong Chen

The process

MASK PROJECTION STEREOLITHOGRAPHY (MPSLA) is an additive manufacturing technique similar to Stereolithography (SLA), but it builds up objects layer-by-layer. A digital micromirror device (array of mirrors, each corresponding to a single pixel, which may either be in the ON or OFF state) uses a UV laser to project a cross-section of the object into a bath of liquid photo-sensitive polymer. This cures an entire layer at once. When each layer is cured, the part is lowered on a platform into the bath to allow a new layer of liquid polymer to be wiped across the surface and the process repeated. Cleaning followed by post-production UV curing is required to completely solidify the prototype. Fabricating a part using this method requires a CAD model, from which the cross-sections are derived.

The process is also known as Digital Light Processing (DLP) and is the closest alternative to solid ground curing which is now obsolete.

Process schematic



Tradenames

3SP

Material compatibility

Polymers - thermoplastics	✓
Polymers - thermosets	✓

Shape

Circular prismatic	✓
Non-circular prismatic	✓
Flat sheet	✓
Dished sheet	✓
Solid 3-D	✓
Hollow 3-D	✓

Economic compatibility

Economic batch size (units)	1	-	10	

Physical and quality attributes

Mass range	0.022	-	8.38	lb

Process characteristics

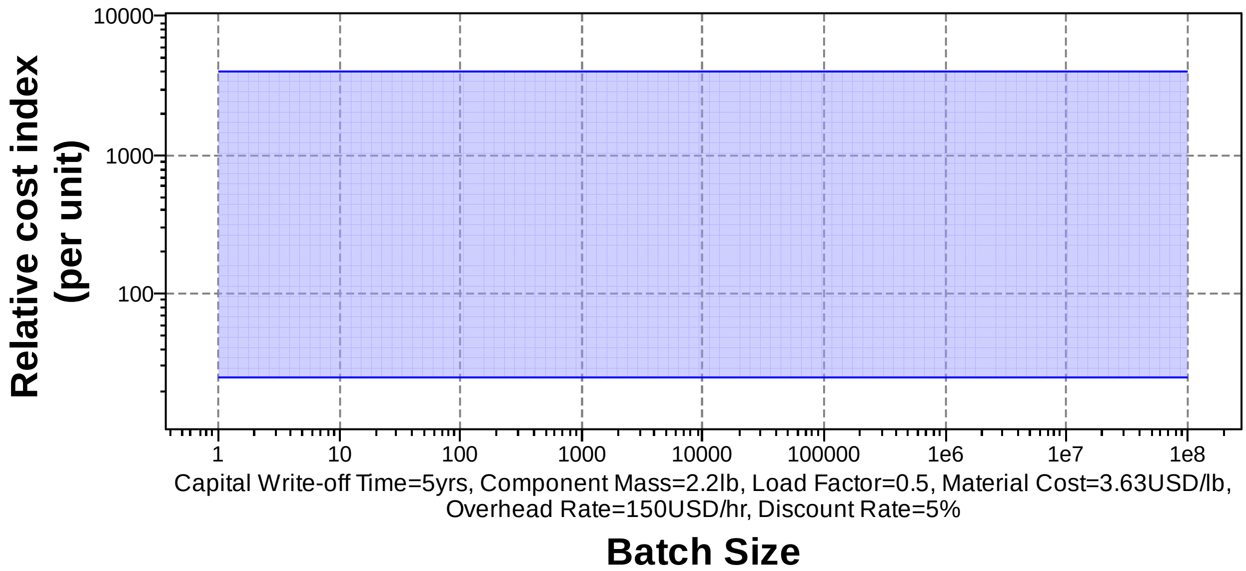
Primary shaping processes	✓

Discrete	✓
Prototyping	✓

Cost model and defaults

Relative cost index (per unit)	24.6	-	3.94e3

Parameters: Material Cost = 3.63USD/lb, Component Mass = 2.2lb, Batch Size = 1e3, Overhead Rate = 150USD/hr, Discount Rate = 5%, Capital Write-off Time = 5yrs, Load Factor = 0.5



Capital cost	2e3	-	2.5e5	USD
Material utilization fraction	0.65	-	0.75	
Production rate (units)	0.04	-	12	/hr
Tooling cost	0	-	0.1	USD
Tool life (units)	1e5	-	1e6	

Supporting information

Design guidelines

Requires support structures (which can later be removed) in addition to the main body of the object for

Technical notes

The build envelope (L x W x H) ranges from 60 x 45 x 100 mm for dental and hearing applications to 457 x 457 x 457 mm.
Typical layer thickness is 25 - 150 µm.
The resin is cured at around 3 - 25 mm per hour in the z-direction.
Degradation when exposed to light can occur rapidly if UV protective coatings are not applied.

Typical uses

Making prototypes and models quickly from CAD systems. Dental restorations and hearing aid shells.

The economics

Prices range from around $1000 for desktop machines to $16000 for industrial

The environment

Photopolymers are thermoset materials and cannot be melted again for reuse. Care needed with environmentally hazardous solvents used to clean up models. The resins are volatile, requiring good ventilation.

Links

MaterialUniverse

Reference