Digital Materials

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The Science of Digital Fabrication, March 7, 2013
Digital Materials

Hillis, Silverman, 1975
Digital Materials

rsb.info.nih.gov/ij/images/
Digital Materials

Figure 2 GIK structures of different sizes & shapes: (a) meter (in plywood), (b) centimeter (plywood), (c) millimeter (celluloid), (d) μm (Kepton). You can see the mm and cm scale structures side by side in (c). The μm structure is on top of a dime for scale purposes.

Figure 11 Error prevention: the x position of a piece in a GIK structure is constrained by the other GIK parts in the structure. Therefore the larger the structure along the y axis and the smaller the variation of the part's x position as measured here.

Figure 3 GIK parts made out of different material: plywood, Plexiglas, aluminum and fiberglass composite material, stainless steel, transparency (celluloid) and cardboard.

Figure 12 Material Tuning: one can vary the percentage of sites occupied in a GIK structure and therefore tune the mechanical behavior of the structure. Shown here: the variation of the compression modulus (the slope of load/extension graphs) for 4 different occupancies.

G. Popescu, N. Gershenfeld, T. Mahale 2006
Digital Material Electronics

Copper 0.02” thick

Mica Laminate 0.02” thick

Ward 2009

?
Digital Material Mechanics

Calisch 2013

NASA FS-1997-07-24-LaRC
Aerostructures

Boeing 787
Goal ~144 hour assembly
Digital Composites
This material is currently under review at an academic journal, and is not available for other press prior to publication. If you need a copy of this slide for any other reason, please contact me at kenny@cba.mit.edu

Thanks!
Ultra-Light Materials Modulus Scaling with Density

- uni-directional aligned CFRP solid
- directional aligned CFRP cuboct digital composite
- quasi-isotropic CFRP solid
- lattice composite (T)
- acrylic solid
- acrylic cuboct lattice
- graphene cork (T)
- silica aerogel composite (T)

\[ E \propto \rho^{1.5} \]

- E\( \propto \rho \)

Schaedler 2011
Qiu 2012

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Thanks!

high camber (lift+, speed-)
Aerostructures

Vickers Wellington, 1935
24 hour production

Boeing 737
~1 million parts, ~1 million fasteners, ~24 hour assembly

Eiffel Tower, 1889
18,000 strut members, 2.5 million rivets, ~2 years
PROGRAMMABLE MATTERS

FLOOD CONTROL: ACTION NECESSARY

LEVEE DANGER

FEDERAL EMERGENCY PREVENTION & M.

LEVEE SUPPORT MISSION
DESTINATION: 29.98 70.25

8 MI OF LEVEE, 6 HOURS: 4 ASSEMBLERS + NAT.

PAYLOAD DELIVERED
COMS SUPPORT MODE

DEVICE OF MASS CONSTRUCTION

BACK TO RARE

THE CENTER FOR
BITS AND ATOMS