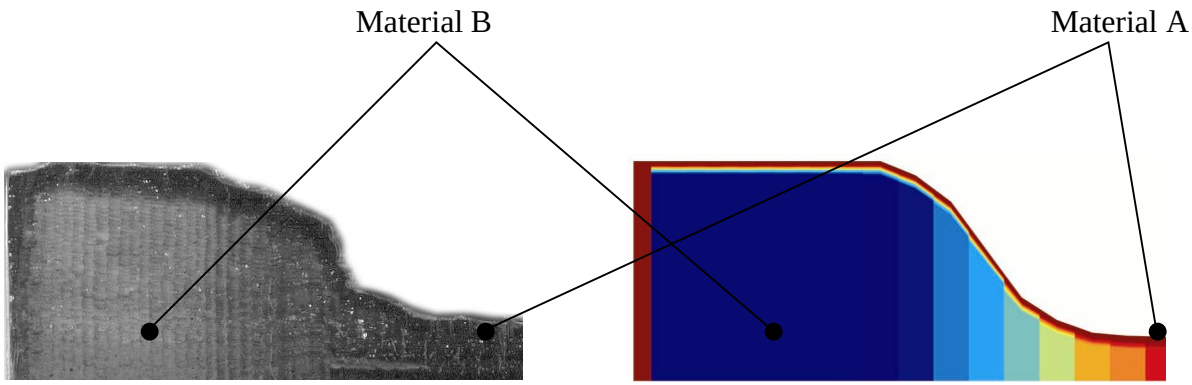
Project Title: ***Computer Aided Design Representation of Heterogeneous Solids***



A Gradient Flywheel Manufactured on the LENS Apparatus

Project Leader: Stephane Morvan, Ph.D. Candidate
Tel: (864) 656-7176
mail-to: smorvan@ces.clemson.edu
Project status: Proposal
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Project Abstract:

The next generation of Rapid Prototyping Machines will allow parts made from multiple materials to be manufactured in a single process. The introduction of multiple materials requires the specification of the material composition at any location within the solid. Conventional solid modeling schemes (CSG, B-Rep…) fail to capture information about the material distribution inside an envelope, as the task of representing solids is oversimplified to the representation of their enclosing boundary, hence assumes a homogeneous material distribution.
This research effort aims at exploring possible representation schemes for arbitrary 3D material distributions, regardless of the nature of the distribution (gradient or binary.) The techniques employed here are built upon conventional surface interpolation techniques extended to volumes and compositions, using a mapping from a 3-Dimensional parameter space to a hyperspace:

$$\text{Find a mapping such that: } \begin{cases} [a,b]\times[c,d]\times[e,\ f]\subset\Re^3 \rightarrow v\times G\subset\Re^{n+3} \\ (u,v,w)\rightarrow\left(x(u,v,w),\ y(u,v,w),\ z(u,v,w),\ \vec{m}(x,y,z)\right) \end{cases}$$

Prof. Georges Fadel
Mechanical Engineering Department
Clemson University
Clemson, SC 29634-0921
USA

Phone: (864) 656-5620
Fax: (864) 656-4435
mail-to: gfadel@ces.clemson.edu
http://design.eng.clemson.edu/credo/

Prof. Georges Fadel
Mechanical Engineering Department
Clemson University
Clemson, SC 29634-0921
USA

Phone: (864) 656-5620
Fax: (864) 656-4435
mail-to: gfadel@ces.clemson.edu
http://design.eng.clemson.edu/credo/