

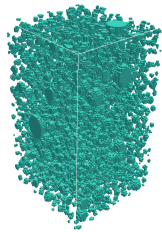
# Microstructure statistics to macroscale properties

Dan Bolintineanu, 1516

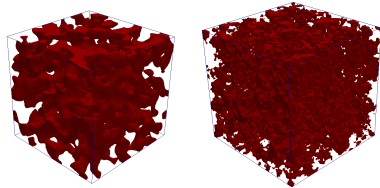
dsbolin@sandia.gov

SAND2017-6048PE

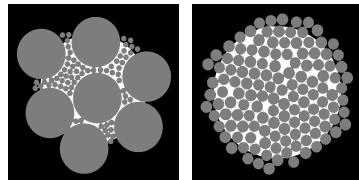
## (Micro)structure



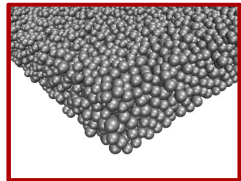
Polymer foam microCT  
(courtesy Enrico Quintana)



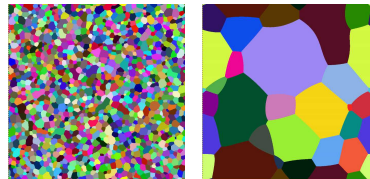
Porous ceramics (Corning CRADA)



Sintered ceramics, phase field simulation (courtesy Fadi Abdeljawad)

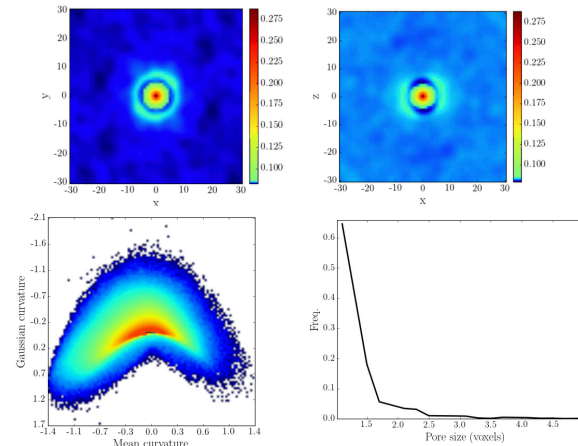


Particle pack from DEM simulations (AM)



Polycrystalline metals  
(Additive Manufacturing, BQ LDRD)

## Statistical descriptors



### Simple (scalar) metrics

- Volume fraction(s), tortuosity, specific surface area

### Spatial correlations

- 2-point volume correlations
- Volume/surface, surface-surface correlations

### Topology metrics

- Lineal path/chord length distribution
- Graph-based

### Pore/particle/grain distributions

(size, shape, surface area distributions)

### Local geometry, e.g. curvature distributions, pore size distribution, etc.

### Scaling properties

## Data Science!

### Predict properties (regression?)

- Effective conductivity
- Permeability
- Elastic modulus
- Yield, fracture

**Compare structures**  
(across samples, simulations to experiments)

### Classification

### Feature identification

**Inform macroscale constitutive models**

**Incorporate/inform manufacturing process characteristics**

...