



SAND2016-6460PE

EOS Table Interpolation

A Brief Overview and My Path

JOWOG32Mat EOS Workshop
July 14, 2016

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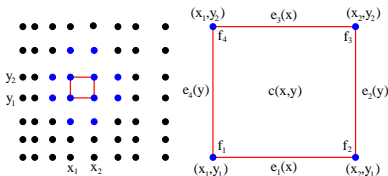




Points to Remember

- ▶ **Hydrocodes query EOS models**
 - ▶ neither interpolation scheme nor data table are, by themselves, EOS models
- ▶ **Tabulation Goals**
 - ▶ Analytic models are slow compared to look up/interpolation
 - ▶ Must ensure interpolation scheme preserves speed advantage
 - ▶ Interpolated model should accurately represent original
 - ▶ Inversion of tables should be avoided when possible

Interpolation Techniques



Patches

- ▶ Interpolation surface defined on polygons
- ▶ Support can be local (e.g. standard SESAME) or global (e.g. splines)
- ▶ Many forms available for the surface:
 - ▶ Basis functions — only need values at nodes
 - ▶ Bezier surfaces — easy to define continuity conditions
 - ▶ Splines — many varieties and very flexible
 - ▶ Special polynomial forms with blending methods

Patchless (mesh free) methods

- ▶ Typically depend on a neighborhood of points for support
- ▶ Tuned regression estimator method (expensive)



Interpolation Features

Continuity

- ▶ C^n denotes continuity in interpolated value and up to n th order derivatives of the value
- ▶ n depends on form, interpolant degree, and available data
- ▶ Most common/fast forms are C^0
- ▶ C^n usually requires $2n$ th order derivative information
- ▶ Triangles can satisfy C^n with only n th order derivatives
- ▶ Polynomial order m usually satisfies $m \geq 2n + 1$

Conditions on tabulated values

- ▶ Stability – thermal and mechanical

$$c_V \geq 0 \quad K_T \geq 0$$

- ▶ Consistency – are the values from the same potential?

$$P = TP_T + \rho^2 E_\rho$$

- ▶ For most interpolation schemes care must be taken to ensure these conditions are met

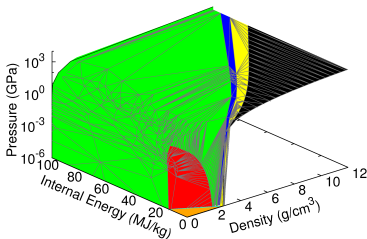
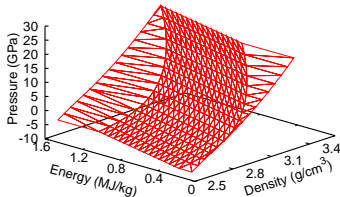
My Path

Moving to triangles as the preferred interpolation patch

- ▶ Look ups slightly more costly
- ▶ Easy refinement/adaptability
- ▶ Currently C0 interpolation
- ▶ Pursuing C2 and C3 methods with subdivided Bezier nets

UTri is the data storage format/interpolation method

- ▶ Supports both structured and unstructured meshes
- ▶ Tree based look ups
- ▶ Extensible to multi-state tables, path storage





Discussion Points

- ▶ What are others' plans?
- ▶ Other novel approaches to interpolation?
- ▶ Ways to specify interpolation for a specific table?
- ▶ Alternative verification methods for interpolation?