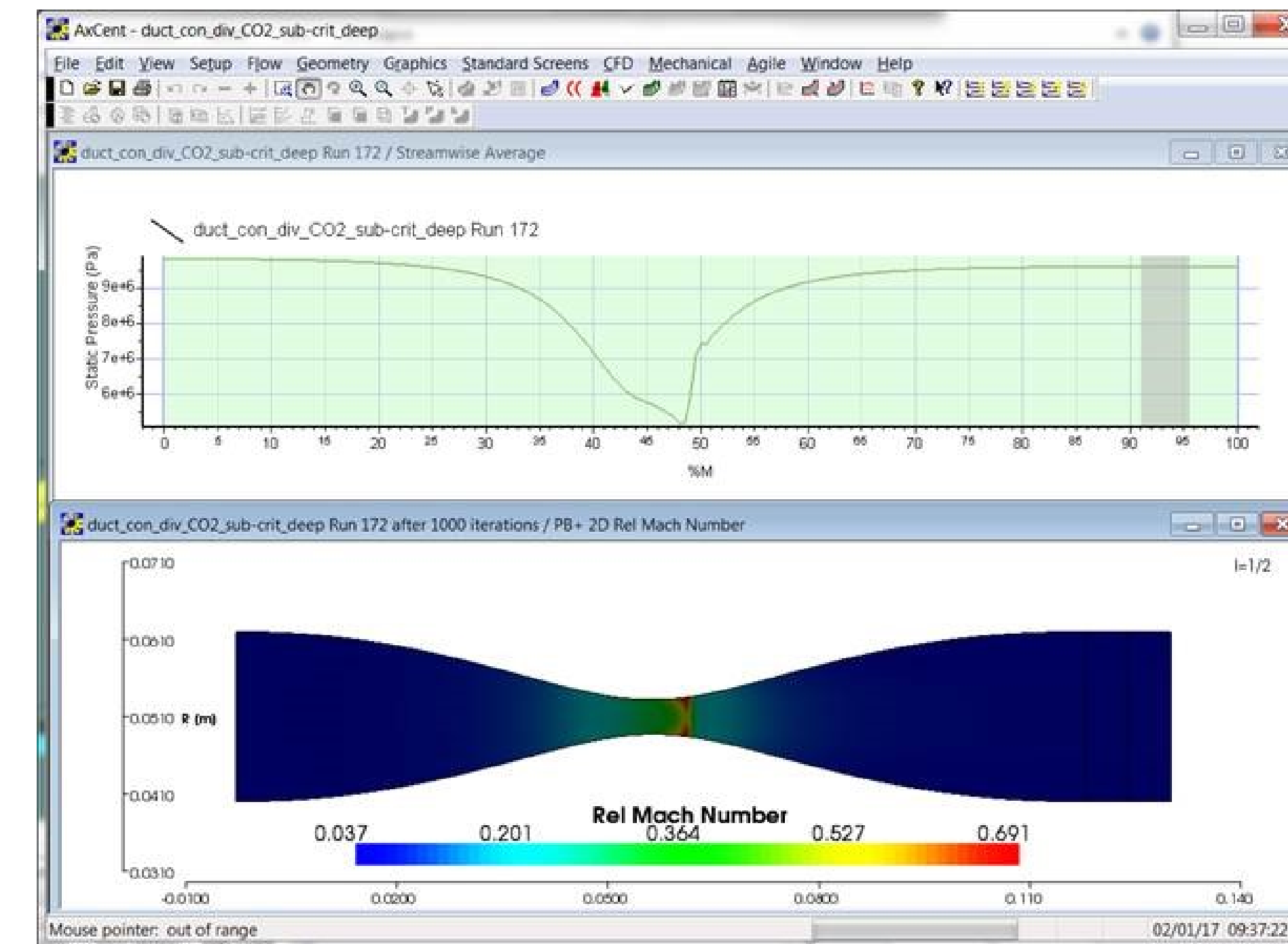
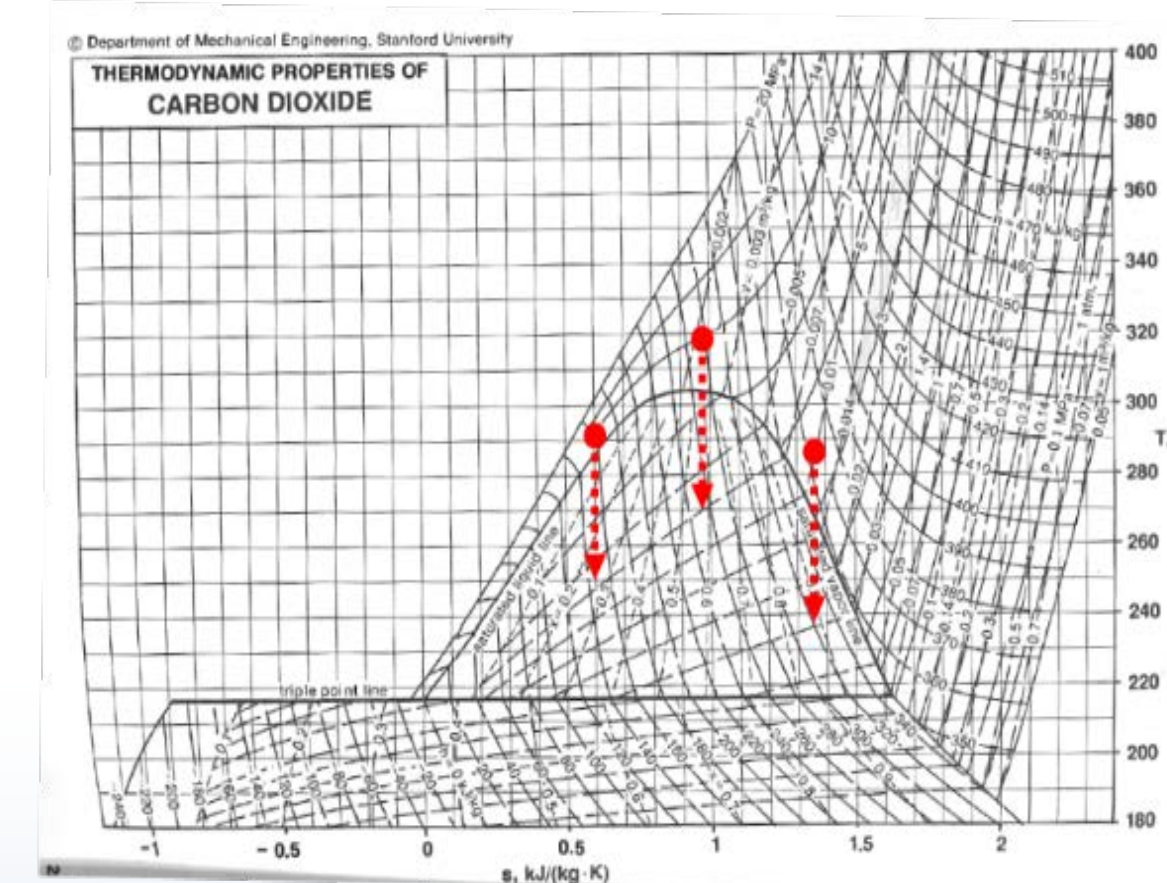
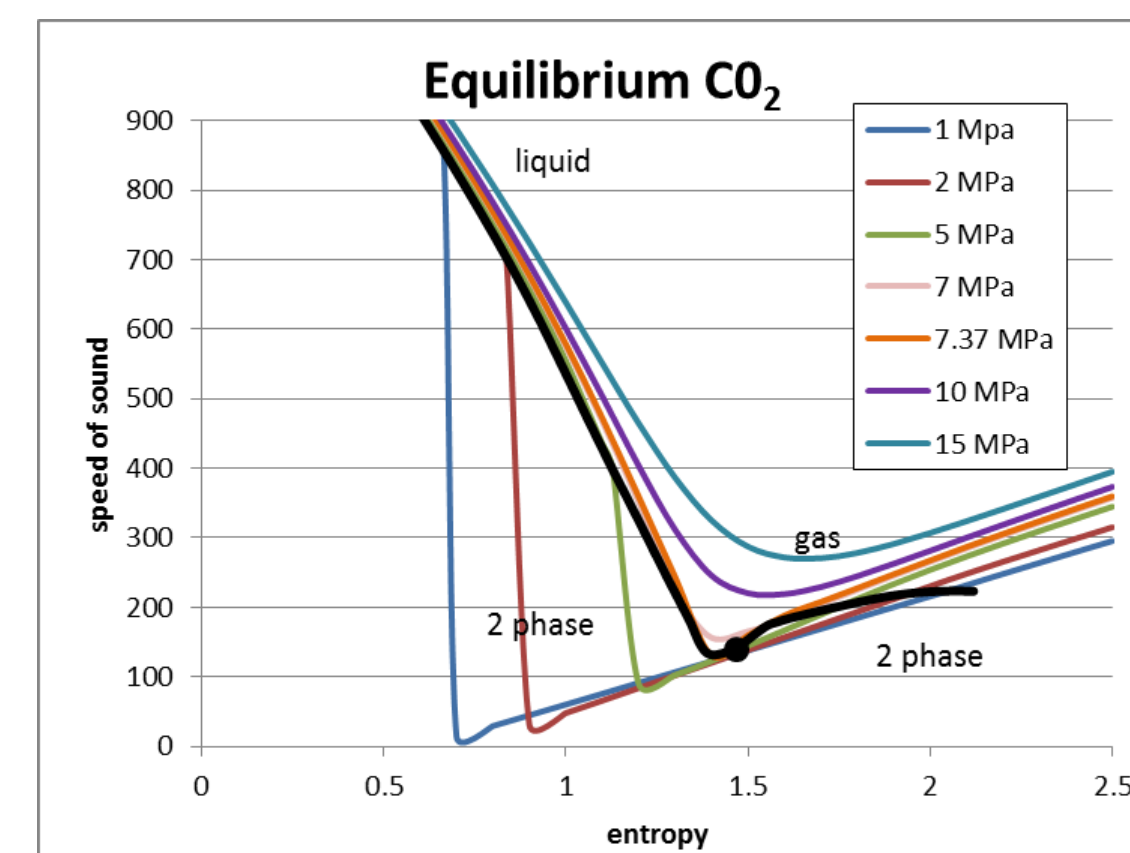
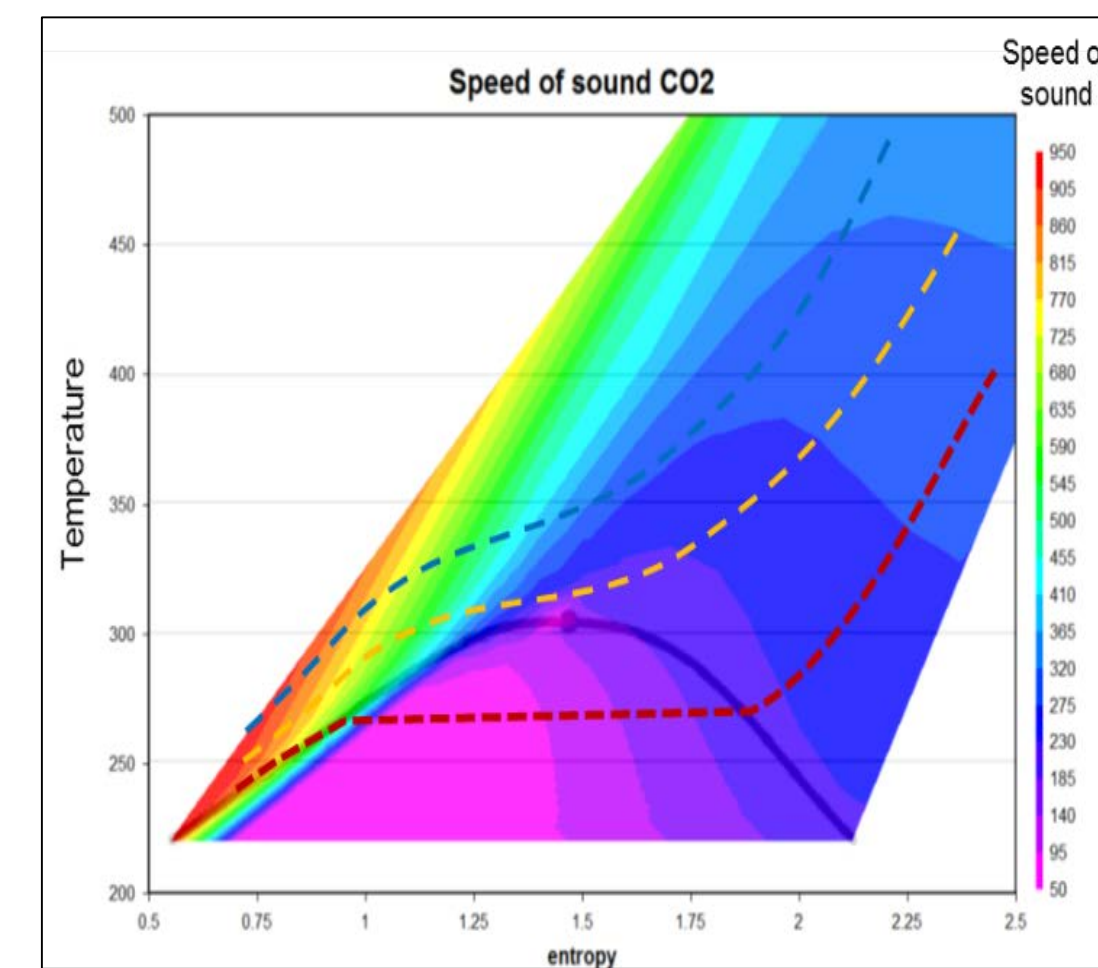
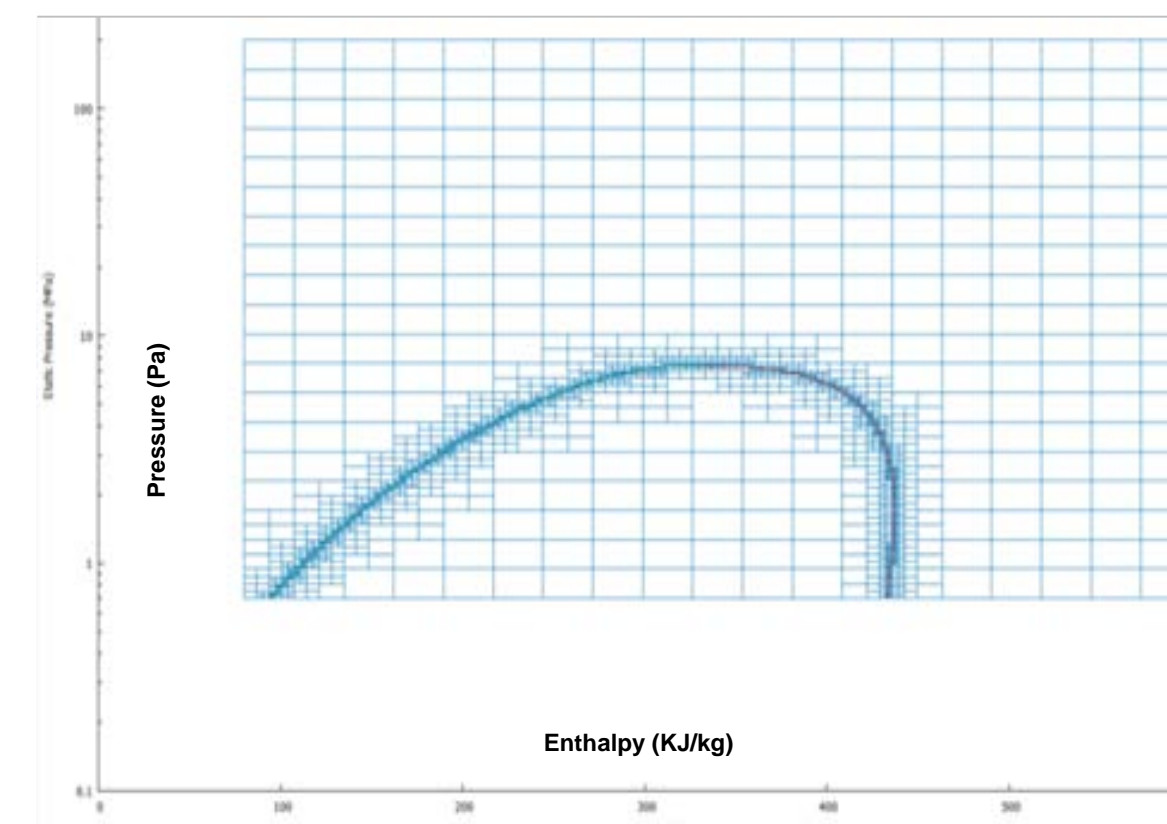


Atypical Fluid Behavior on the Liquid Side of the Saturation Line of CO₂ With Implications for Compressor Design

Mark R. Anderson (Concepts NREC, LLC)

- sCO₂ turbomachinery design requires a complicated equation of state
 - NIST REFPROP is “gold standard” for accuracy
 - Computational costs are very high
 - Table interpolation method often used
 - Method used in Concepts NREC’s product line is locally refined cells near the saturation line
 - Accurate, robust, fast
- Properties of CO₂ are highly non-linear near the critical point
- Properties on liquid side of saturation dome are also super non-linear
 - Speed of sound is the dominate non-linear effect on the liquid side
- One dimensional nozzle studies used to determine flow behavior



- CFD results show choking can occur as Mach numbers well below 1.0
- Shock like behavior occurs at Mach numbers far below 1.0
- Effects confirmed with 1D calculations using REFPROP
- Nonlinear effects on the liquid side of the saturation dome can pose significant risks for sCO₂ compressor designs

