

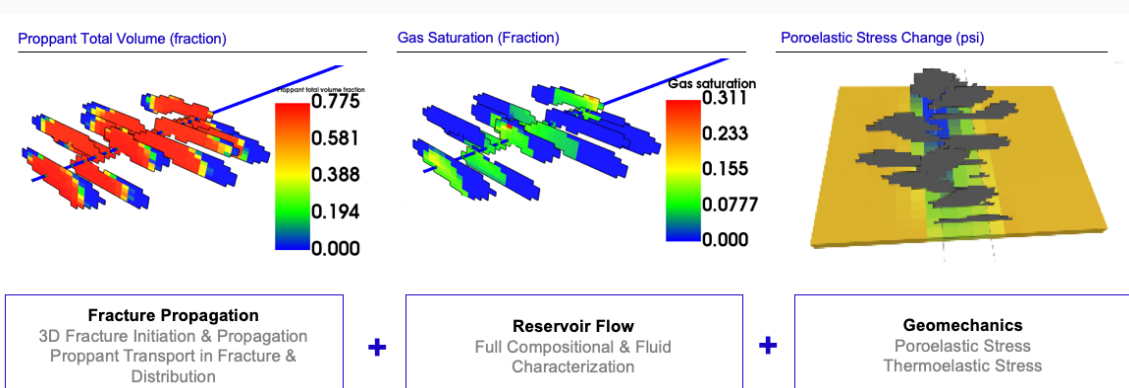
## Simulate the entire life cycle of an unconventional well in a SINGLE SIMULATION

ResFrac is the first three-dimensional, fully compositional simulator to seamlessly couple hydraulic fracturing, wellbore, geomechanical, and reservoir simulation. A single simulation captures the life-cycle of an unconventional well or pad: hydraulic fracturing, shut-in, closure, production, and any subsequent child fracturing or refracturing.

By coupling processes throughout the life of a well into a single simulation, ResFrac more accurately models well performance and is uniquely capable of modeling parent-child relationships, shale EOR, refracs, and more in an integrated platform that provides a collaboration platform across the many technical petroleum disciplines.

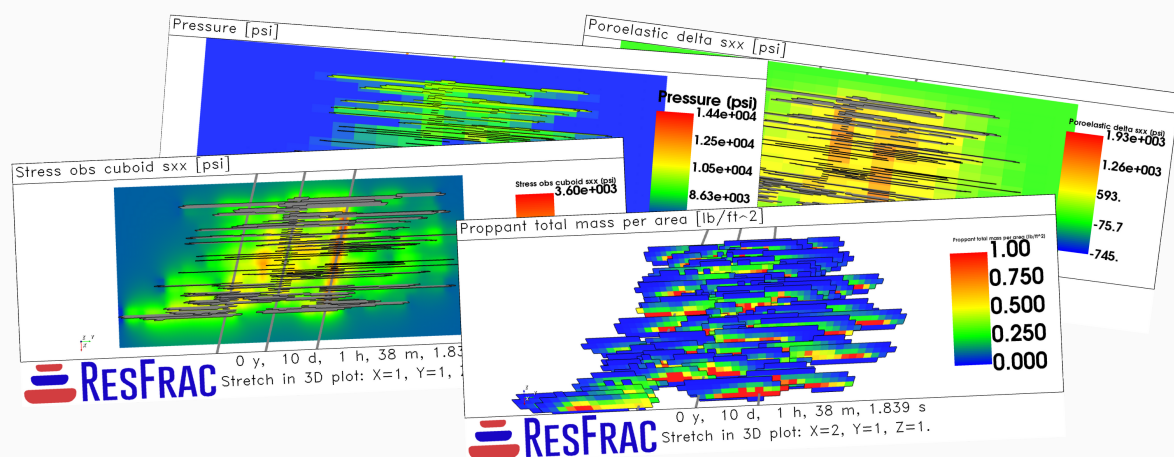
Combining these capabilities allows frac designs to be compared directly on the basis of predicted production instead of relying on proxies or laborious handoffs between multiple software packages. Handoffs from fracture simulators to RTA or reservoir simulators are often 'black box' and involve a loss of information and physics. ResFrac avoids these problems by seamlessly simulating fracturing and production together, in a single, continuous model.

## ResFrac Integrates Three Software Capabilities into One



SHORTEN THE  
HYDRAULIC  
FRACTURING  
LEARNING CURVE  
BY ALLOWING  
USERS TO  
COLLABORATE  
AND TEST NOVEL  
IDEAS IN A  
DIGITAL  
ENVIRONMENT

Robust Numerical Solution, Maximizes Accuracy for Field Applications



## ANNUAL RESFRAC PRO SOFTWARE LICENSING

- Choose between license seats or simulation hours
- Includes unlimited installations of builder and visualization tools
- Integrate and match well data
- Simulate frac hits, parent-child relationships, EOR and IOR, fracture sequencing operations, multi-bench, multwell pads, perforation erosion, limited entry and diverter.
- Includes basic training and support
- Advanced training and/or weekly coaching calls with ResFrac senior consulting engineers available

## PROFESSIONAL SERVICES: SIMULATION AS A SERVICE

- Leverage the experience of our senior consulting engineers to integrate and match your well data
- ResFrac Engineers run and analyze simulations
- Turnkey projects in 4-6 months (timeline estimate on next page)
- Frequent check-ins (see the process firsthand) to ensure alignment on processes and deliverables
- Projects include reports, presentations, and all simulation files
- Can be done as a stand-alone project or in conjunction with licenses
- Model appropriate timing of fracs: zipper, sequential, simultaneous, etc.
- Simulate EOR and IOR in unconventional wells: CO2 injection, miscible gas, etc.

MORE THAN 30% OF  
RESFRAC USERS  
ARE FIRST-TIME  
SIMULATION USERS.

OUR INTEGRATED  
HELP AND  
TUTORIALS MAKE  
THE SOFTWARE  
APPROACHABLE  
AND EASY TO USE

Contact us at [info@resfrac.com](mailto:info@resfrac.com)  
for pricing and more information.

## SIMULATION AS A SERVICE: TYPICAL PROJECT CADENCE

Simulation studies are expected to take four to six months depending on the scope of the project and number of iterations required for a history match. The duration of this project is contingent on mutual availability of both parties for regular check-ins and feedback. The project consists of five phases, each of which concludes with a meeting with the client.

### INITIAL MODEL CONSTRUCTION (2 WEEKS)

- Objective: Confirm data loaded correctly
  - Correct well trajectories, spacing
  - Correct static properties
  - Correct frac design
  - Definition of boundary conditions
  - Definition of relative permeability facies

### HISTORY MATCH UPDATE (2-4 WEEKS)

- Objective: Evaluate initial history matching and observations
  - Frac half length
  - Number of fracs
  - Production/pressure data
  - Offsetting strain data from fiber optics

### FINAL HISTORY MATCH AND SENSITIVITY PARAMETERS (2-6 WEEKS)

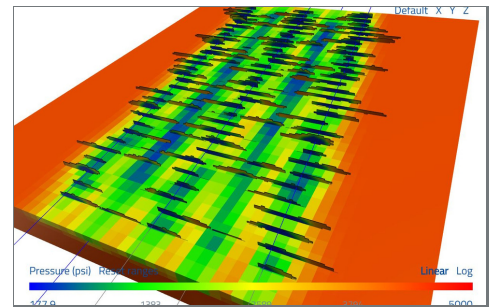
- Objective: Align on representative history match
  - Sensitivity of history match and dominant parameters
  - Explanation of processes observed
  - Define sensitivity/optimization parameters to be studied

### SENSITIVITY REVIEW (4 WEEKS)

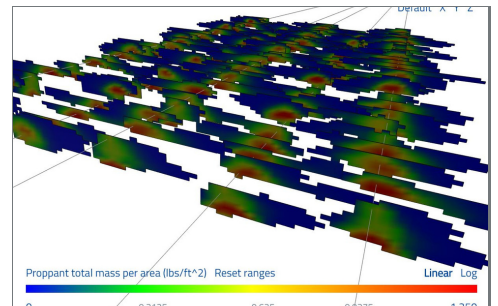
- Objective: Evaluate results of initial sensitivity analysis/ optimization and explain any discrepancies with intuition.
  - Discussion of optimal cases and designs

### PRESENTATION OF RESULTS (4 WEEKS)

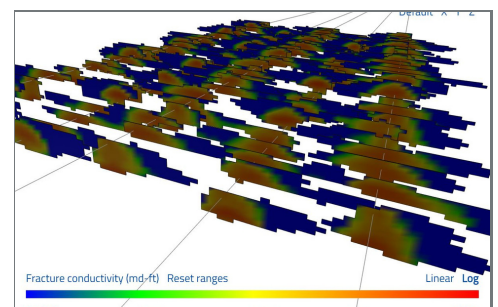
- Objective: Summarize the entire process and findings
  - Final report
  - Generally involves larger audience
  - Delivery of simulation files and trial license
    - Possible in-person software training session if pursuing a license
    - Option for weekly coaching services moving forward



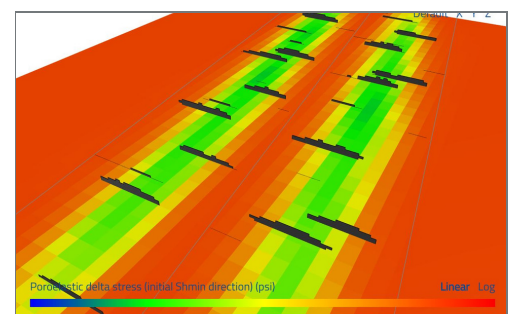
a. Pressure distribution in fractures and matrix. Fractures can be effectively infinite conductivity or finite conductivity depending on proppant placement, permeability of proppant pack, and permeability of formation.



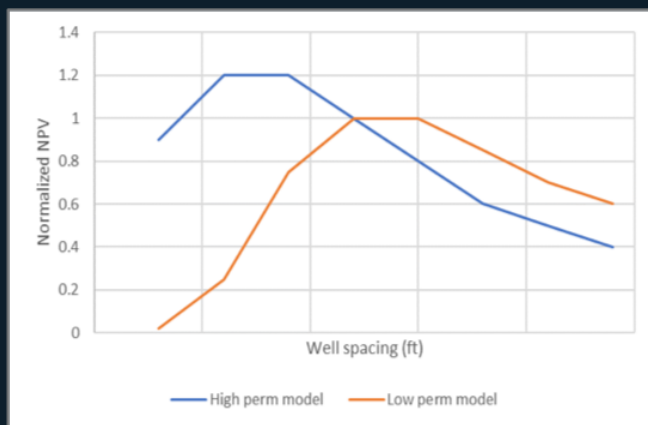
b. Proppant distribution (above) directly affects aperture of the fractures and the resulting conductivity (c).



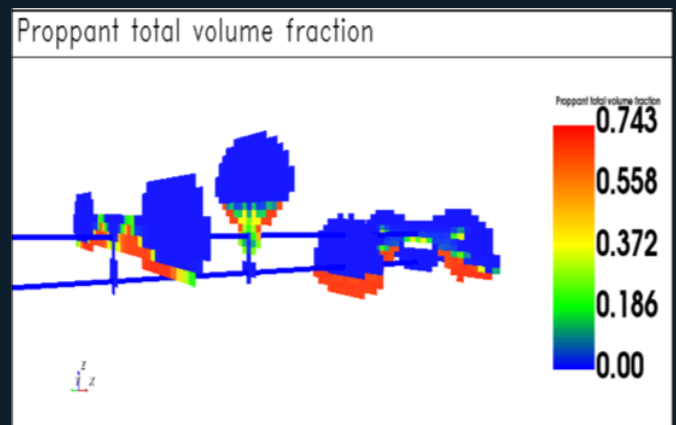
c. Conductivity directly affected by aperture of the fractures and proppant distribution.



d. Pressure depletion in the matrix results in a poro-elastic stress change, a critical component of child fracs and refracs.



NPV analysis for well spacing with high and low permeability assumptions



Fracture collision during child well frac with remobilization of proppant in parent (upper) well

## EVALUATE DESIGNS BASED ON PRODUCTION FORECASTS

- No need for unreliable proxies or complex hand-offs between software
- Entire well life cycle in a single simulation

## INDUSTRY-LEADING REALISM IN FLUID FLOW AND PROPPANT TRANSPORT

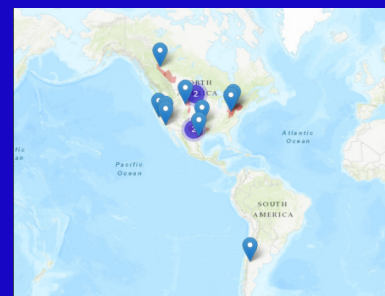
- Fracture fluid flow includes multiphase, non-Darcy, and non-Newtonian flow effects
- Proppant transport includes bulk gravitational convection, gravitational settling, hindered settling, clustered settling, screenout, and the effect of proppant on slurry viscosity
- Model a wide variety of fluid additives: tracers, non-Newtonian fluids, crosslinking gels

## SIMULATE COMPLEX FRACTURING OPERATIONS

- Multi-well pads, parent-child wells, and/or refracturing in a single simulation
- Model appropriate timing of fracs: zipper, sequential, simultaneous
- Simulate EOR and IOR in unconventional wells: CO<sub>2</sub> injection, miscible gas, etc.

## BROAD APPLICABILITY

- ResFrac is used by over 30 companies split between license customers and Simulation as a Service customers
- Projects and technical experience span every major shale play:
  - Midland/Delaware Basins in the Permian, Bakken/Three Forks, Marcellus, Utica, SCOOP/STACK, Eagle Ford, Montney, Powder River, Vaca Muerta



d. Map of ResFrac use areas.