PFC™ VERSION 7.0

General Purpose Distinct-Element Modeling Framework

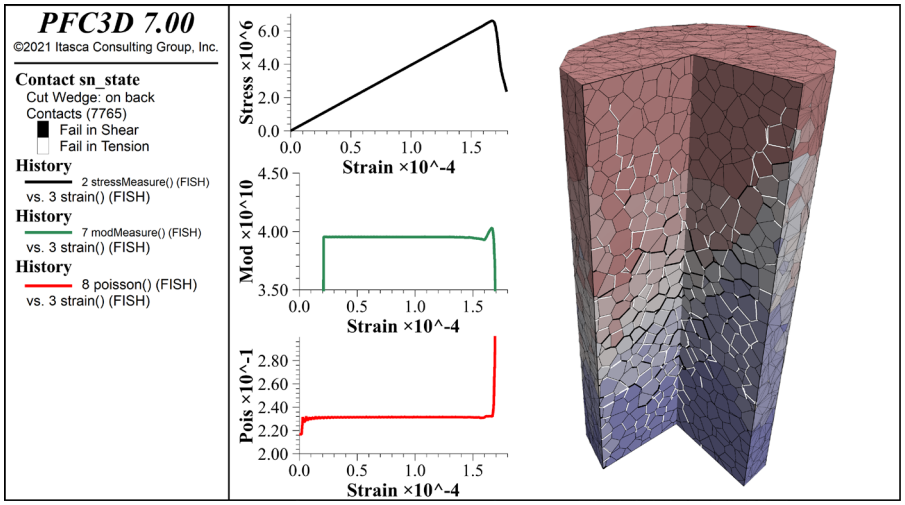
ABOUT *PFC*

Particle Flow Code (*PFC*) is a general purpose, distinct-element modeling (DEM) framework that is available as two- and three-dimensional programs. *PFC Suite* includes both *PFC2D* and *PFC3D*, or *PFC2D* is available separately. *PFC* simulates synthetic granular and solid materials as an assembly of variably-sized, rigid particles (disks or convex polygons in 2D; spheres or convex polyhedra in 3D). Individual particles of any type can be rigidly connected as "clumps" to model complex, concave particles. Material behavior depends on particle-interaction (contact) laws — including force at a distance — that update particle movements. Contact models may also simulate bonding and breakage. *PFC* includes 16 contact models. Users may create new models using C++ or *FISH*. *FLAC3D* components like zones* and structural elements are loaded in *PFC* to combine the power of DEM and continuum modeling. While designed with geomechanical and material process engineering in mind, *PFC* has been used extensively in other fields (e.g., carbon nanotube mechanics, molecular dynamics, astrophysics, heart cell behavior, 3D printing, tool design, and magnetic material interactions).

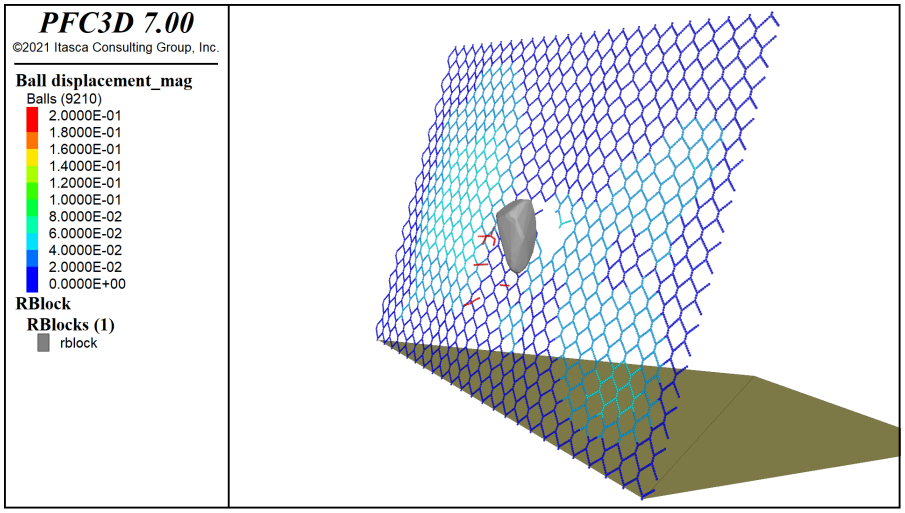
FEATURES

- General design for multiphysics modeling
- Multi-threaded solution with no CPU locks or annual fees
- Includes 16 built-in contact models for a rich library of material behaviors **UPDATED**
- FISH scripting (including multi-threaded FISH) adds powerful functionality to parameterize, analyze, review, and modify nearly every aspect of the simulation, even during execution
- Python scripting adds more flexibility with access to a library of scientific, mathematical, and visualization libraries
- Couple PFC to third-party Computation Fluid Dynamics (CFD) programs
- Perform thermal-mechanical analysis
- FLAC3D structural elements (beams, cables, piles, shells, and hydrid bolts) available **NEW**
- Interface coupling between PFC3D particles and FLAC3D zones, and domain bridging for dynamic modeling
- Built-in project management tools, text editor, automatic movie-frame generation, and extensive plotting tools
- Commands are intuitive and easy to learn and to apply
- Practical and straightforward material property assignments
- Powerful periodic space support
- Discrete Fracture Networks (DFNs) can be generated using imported fractures or built-in statistical generator
- Operates on Windows and Ubuntu Linux **NEW** operating systems

*FLAC3D 7 license required.



▲ Virtual UCS test of a rock specimen using voronoi rigid blocks and a spring network contact model.



▲ *PFC3D* model showing a simulated rock slide barrier fence.

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- Track histories of model results to compare to physical monitoring and instrumentation data
- Events that modify the model state are recorded, allowing for undo, playback, or reuse of previous modeling work
- Results files permit users to select which model data and results to save for more compact files for archiving, distribution, and post-processing
- Bundle project files into a single file for easy distribution and archiving
- Help documentation available as an integrated panel or in a browser
- Inline Help for command completion in the editor or on the command line

EASY MODEL CONSTRUCTION

- Simple commands for controlling particle size distribution and target porosity
- Bricks (compacted, bonded assemblies that may be replicated many times) can rapidly construct large models
- Easily convert DXF or STL files into model geometry and geometry into walls
- Assign conveyor velocities to wall facets to simulate spinning drums or conveyor belts
- Set domain boundaries to stop, destroy, or reflect particles or to be periodic, including periodic space distortion
- Static or mobile particle inlets generate streams of balls, clumps, and/or rigid blocks into the model during cycling NEW
- Stress installation schemes for ball and rigid block packings NEW

CLUMPS

- Clumps can be easily generated from templates
- Bubble pack command automatically creates clump templates for a specified triangulated DXF or STL surface
- Clump together collections of balls and/or convex rigid blocks NEW
- Clumps can break during cycling while retaining contacts

RIGID BLOCKS

- Convex rigid blocks can be used for simulating non-spherical objects and Bonded Block Models (BBMs)
- Model concave shapes directy as smooth rigid blocks rather than pebbles NEW
- Densify rigid blocks via cutting NEW
- Cut rigid blocks during cycling, retaining contacts NEW
- Easily apply boundary conditions to rigid blocks NEW

CONTACT MODELS

- 16 built-in contact models including smooth- and flat-joints for jointed rock, Burger's for creep, Hertz for impact dynamics, linear dipole for magnetic interactions NEW, EEPA and JKR adhesion models NEW, and the spring network for rigid bonded block modeling (BBM) NEW
- Complex models involving heterogeneous material properties can be synthesized in a straightforward manner using the Contact Model Assignment Table (CMAT)
- Use C++ or *FISH* NEW contact models to create custom contact models to modify contact physics

THERMAL ANALYSIS

- Simulate transient heat conduction
- Model the development of thermally induced strains and forces
- *PFC* supports both thermal-only and coupled thermal-mechanical analysis

FISH SCRIPTING

- Customize models by adding new physics while cycling
- Built-in text editor provides syntax highlighting and Inline Help for simpler, faster model generation
- Text editor includes a built-in, automatic conversion tool to translate *PFC* 6 data files for use in *PFC* 7 UPDATED
- Add *FISH* fragments using Inline *FISH* for simple calculations within a command
- *FISH* Control Set graphically displays the current values of *FISH* variables and functions
- Multi-threaded *FISH* for much faster calculations NEW

PYTHON SCRIPTING

- Use Python to manipulate PFC models via the built-in IPython console
- Access powerful Python libraries for advanced mathematical and scientific computations, database integration, data visualization, and GUI customization

DISCRETE FRACTURES

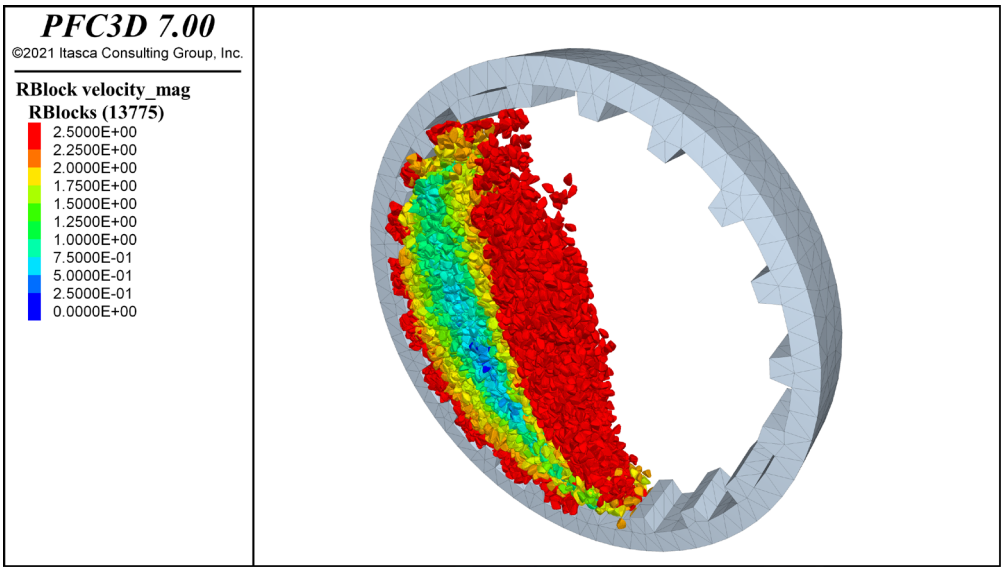
- The Discrete Fracture Network (DFN) module provides an efficient tool to generate and manipulate fractures
- Import/export of fractures from Itasca and Fracman file formats
- Add deterministic fractures and/or generate stochastic fractures
- Fracture family densities may be defined from apparent fracture intensity along borehole(s) and scanline(s), from bulk density or from bulk number of fractures
- Computation of clusters and connectivity properties
- Visualization of fractures, outcrop/tunnel trace maps, and stereonets
- *FISH* and Python access providing the ability for custom DFN creation, analyses, and manipulation

MATERIAL-MODELING

- The *FISHTank* provides a well-documented material-modeling support environment of *FISH* functions for calibrating and simulating lab testing for linear, bonded, flat-jointed, and smooth-jointed ball models
- Lab tests include compression, diametral-compression, and direct-tension

LICENSES

- Desktop (USB key), web NEW, network, and node-lock NEW licenses available
- Two instances can be run on a single computer with desktop or web licenses
- Desktop USB security key is portable between users and computers
- Multiple seats can be assigned and managed with web or network licenses
- Cloud computing possible with web license NEW
- Licenses operate on Windows and/or Ubuntu Linux NEW operating systems



▲ *PFC3D* model showing a simulated aggregate (as rigid blocks) inside a section of a spinning mixing drum.