

Casting Process Modeling Round-Up



This rundown provides a brief review of metal flow modeling software programs available to metalcasters. SHANNON WETZEL, SENIOR EDITOR

Casting process modeling has been used for decades by large automotive companies and high volume casting facilities to improve casting quality and streamline the design process. In recent years, low and medium-production facilities have been investing in the software, as well.

Christof Heisser, president of MAGMA Foundry Technologies, Schaumburg, Ill., said with most high production facilities already using the software, the majority of new customers are small to medium facilities.

Computer operating systems have become more affordable, and the pay-

back on investing in simulation software has been proven. The question for many metalcasters has shifted from “should we invest in modeling software?” to “which software package should we use?”

According to Tony Midea, product development manager for Foseco, Cleveland, the price disparity among vendors seems to be shrinking. But if price is a concern, it should not dictate which software you choose, he said.

“If you are worried about price, lease the program or talk to the vendor about creative ways to finance it,” Midea said. “You will find it’s worth the investment.”

Midea, who has worked extensively with casting process modeling soft-

ware and published several articles on modeling developments and applications in the casting industry, offers 12 questions to consider when investigating purchasing solidification software:

- What specific casting processes was this software originally designed for and what are the areas of expertise?
- How many users are from the industry; how many are from the same type of casting facility?
- Is the software able to accurately model my specific casting process?
- Will I be able to add more capabilities and functions to my software package as my needs change and grow?
- Does it use Navier-stokes solvers—

the industry standard for fluid-flow modeling—for filling analyses?

- Does it have a large, accurate set of thermal properties for casting process materials such as the metal, mold, core, chill and feeding systems?
- How many technical personnel does my company employ? Will the software company support me with the software and foundry-

specific technical issues?

- Is the software company financially stable?
- Is the program user-friendly?
- Does the program support importation of multiple 3-D file formats, such as .stl and STEP?
- How accurate is the program? Will the software company provide detailed documentation of case

studies, particularly with my alloy and casting geometry type?

- Will the company help me calibrate my software to my operations?

MODERN CASTING surveyed several companies offering casting solidification software. The following is a wrap-up of eight versions of metal flow modeling, including their newest features, strengths and unique capabilities.

MAGMASOFT/MAGMA⁵

MAGMA Foundry Technologies Inc.

10 N. Martingale Road, Suite 425
Schaumburg, IL 60173
Tel: 847/969-1001

Website: www.magmasoft.com
Email: info@magmasoft.com

Entry Price Point: \$3,000 a month for a 1-year lease of an entry level package covering the casting process.

Overview: More than 1,500 casting buyers and designers use MAGMA's simulation products. In 2010, the company released MAGMA⁵, the newest evolution of its modular simulation software MAGMASOFT. Magma⁵ 5.2 has extended capabilities for all cast materials and processes and can be optimized at all stages of casting manufacturing.

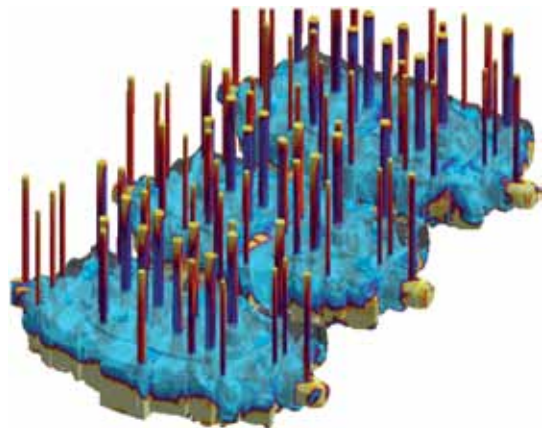
Newest Features: Magma⁵ 5.2 introduces new modes for permanent mold, low pressure sand and low pressure diecasting, as well as hot and cold-chamber diecasting for process-specific

definitions. The software supports process design by controlling process parameters during a simulation run. Process modules for DISAMATIC and investment casting also are available. New developments for the quantitative prediction of as-cast and heat treated local microstructures and properties apply to aluminum, iron and steel casting. The stress module MAGMAstress offers the option to calculate thermally induced casting stresses in permanent molds for all manufacturing steps, including heat treating and finishing, for predicting casting crack problems and distortion.

Software's Strengths: The software is used by a wide range of casting facilities for most materials and processes, especially those facilities producing cast components in automotive and heavy industry applications.

What's Unique: MAGMA's

automatic optimization makes proposals for the right casting layout or optimum process parameters. The virtual test foundry in the computer enables parameter variation and systematic examination of influencing variables leading up to the optimum configuration. The program finds the best possible dimensions and positions of ingates, as well as the locations and sizes of feeders and chills.



Star-Cast

CD-adapco and Access

Nordostpark 3 - 5
90411 Nürnberg, Germany
Tel: 49/911/94643-3

Website: www.starcast.org
Email: info@us.cdadapco.com

Entry Price Point: Not specified.

Overview: StarCast is based on the computational continuum mechanics approach and simulates liquid, solid and gaseous phases of casting, including conjugate heat

transfer, a sharp resolution of the filling front, free-surface fragmentation, motion of trapped gas bubbles in melt, forced and natural convection in the melt and gas flow through porous molds.

Newest Features: Relatively new to the field, StarCast was first released to the public in 2009. The software performs misrun formation predictions, including permeability calculations for the "mushy zone," providing enhanced enmeshment techniques for designing thin-walled castings. A material database allows

the integration of data documentation with casting simulation. Search and retrieval of the data is performed using a graphical user interface.

Software's Strengths: StarCast can simulate casting solidification in gravity casting, tilt-pour casting, low pressure diecasting, centrifugal casting and vacuum casting.

What's Unique: The fully-coupled computational continuum mechanics approach with multi-phase mold filling module enables concurrent computation of fluid flow, temperature and liquid-solid transition.

NovaFlow and Solid CV

NovaCast USA Inc.

200 E. 5th Ave., Suite 125

Naperville, IL 60563

Tel: 312/810-7205

Website: www.novacastusa.com

Email: henrik.barth@novacastusa.com

Entry Price Point: \$59,500, which includes everything except the optional stress module NovaStress. A network license is also available.

Overview: NovaFlow and SolidCV use finite volume method (FVM) a combination of structured finite difference grid (FDM) and fractional areas/volumes for geometry definition that enables the use of few

elements. FVM calculates 10 times faster than FDM with the same or higher accuracy.

Newest Features: Users now can calculate gas in the mold to simulate backpressure, gas flow and porosity. Since the calculations are quick, they can be used for every part without adding considerable time. NovaFlow also has added auto reporting and automatic movie making.

Software's Strengths: NovaFlow and Solid CV are suitable for the common casting processes and materials. The software is particularly beneficial for cast iron (due to its connection with NovaCast's

metallurgical process control ATAS), steel castings and high pressure diecasting. The meshing technology also makes the program especially suited for thin-walled castings and large and dispersed pattern layouts.

What's Unique: The automatically generated meshing and calculation speed means all casting methods can be simulated on an ordinary computer. Metallurgical process data from Novacast's thermal analysis system ATAS can be directly imported and used in NovaFlow and Solid CV, creating a database of information for gray and ductile iron.

SolidCast, FLOWCast and OPTICast

Finite Solutions Inc.

4769 Highland Park Dr.

Slinger, WI 53086-9441

Tel: 262/644-0785

Website: www.finitesolutions.com

Email: dave@finitesolutions.com

Entry Price Point: \$17,500 for SOLIDCast, \$12,000 for FLOWCast and \$8,000 for OPTICast. Price includes site licenses, technical support and updating for a year.

Overview: More than 660 companies and schools use SOLIDCast around the world. It includes

solidification analysis, plus integrated gating and riser design functions. FLOWCast uses computational fluid-dynamics-based analyses to predict and correct filling-related problems. OPTICast is an automatic casting process optimizer, most commonly used to improve casting yield while guaranteeing casting quality.

Newest Features: The software now offers multiple language support, full compatibility with a Windows version in native modes and simultaneous operation of multiple solidification and fluid flow analyses.

Software's Strengths: Finite Solutions products are suitable for any gravity-pouring process, such as sand, investment or permanent mold casting, and any material, with an emphasis on cast irons.

What's Unique: Integrated gating and riser design functions allow the system to use simulation results to help the user create effective rigging design beyond testing an existing pattern layout. Site licensing allows the software to be installed and run simultaneously on any or all machines at a given plant.

WinCast

Simtec

400 S. State St., Suite 110

Zeeland, MI 49464

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Website: www.simtec-inc.com

Email: info@simtec-inc.com

Entry Price Point: \$18,000, which includes preprocessor, mold filling and solidification main processor, as well as porosity prediction.

Overview: Users can use the universal program package to calculate molten metal flow for any casting process. It is a finite element method (FEM)-based code, which enables high precision calculation of solidification and stress and distortion. Mold filling procedures use either a front-tracking

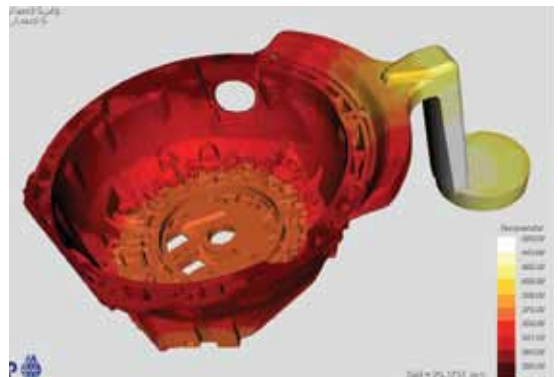
algorithm or the newly developed finite volume method/FEM combination.

Newest Features: WinCast now features a user interface, mpi-supported main processor and reconstructed postprocessor. The software has the capability to save the results as small AVI movies or GIF pictures. The results can be stored as virtual reality modeling language data to send to clients to discuss them on a 3-D basis. Quantitative results, such as porosity, are shown in an ASTM Level distribution; stress and distortion are shown relative to the original geometry.

Software's Strengths: Anyone in the metalcasting facility can use the software without formal training. It can

be used with all main casting processes.

What's Unique: The documentation system stores the complete history of the casting as a follow-up system in the shop. This software combines modeling and planning and can be used as input for commercial administrative systems.



Flow 3-D

Flow Science Inc.

683 Harkle Rd. Suite A
Santa Fe, NM 87505
Tel: 505/982-0088
Website: www.flow3d.com
Email: sales@flow3d.com

Entry Price Point: \$1,000 for a trial license

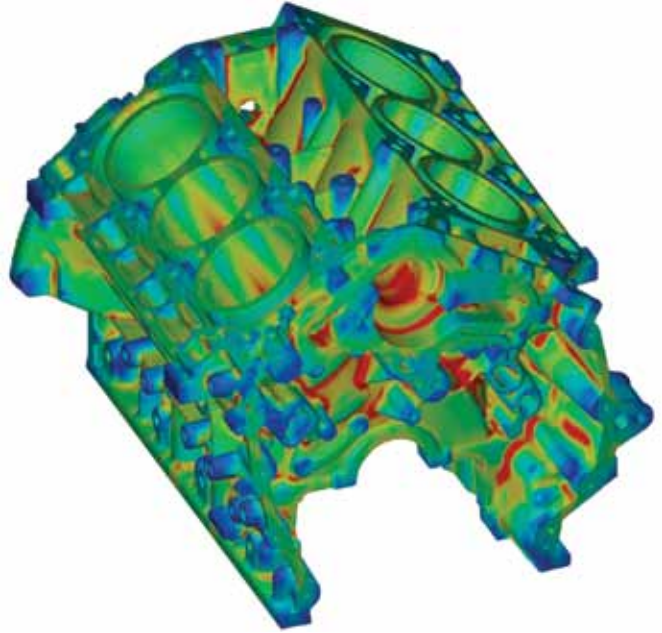
Overview: Flow-3D generates flow and solidification simulation results for casting processes and includes dynamic meshing for easy model setup, a materials property database and extensive post-processing capabilities.

Newest Features: The software now simulates iron shrink with high carbon content metals to predict the formation of graphite and carbide. It also has a fully-coupled thermal stress model that predicts stresses and distortion within a cast part or die. This allows users for the first time to model deformations in the solid state, helping avoid warpage to create better quality cast parts.

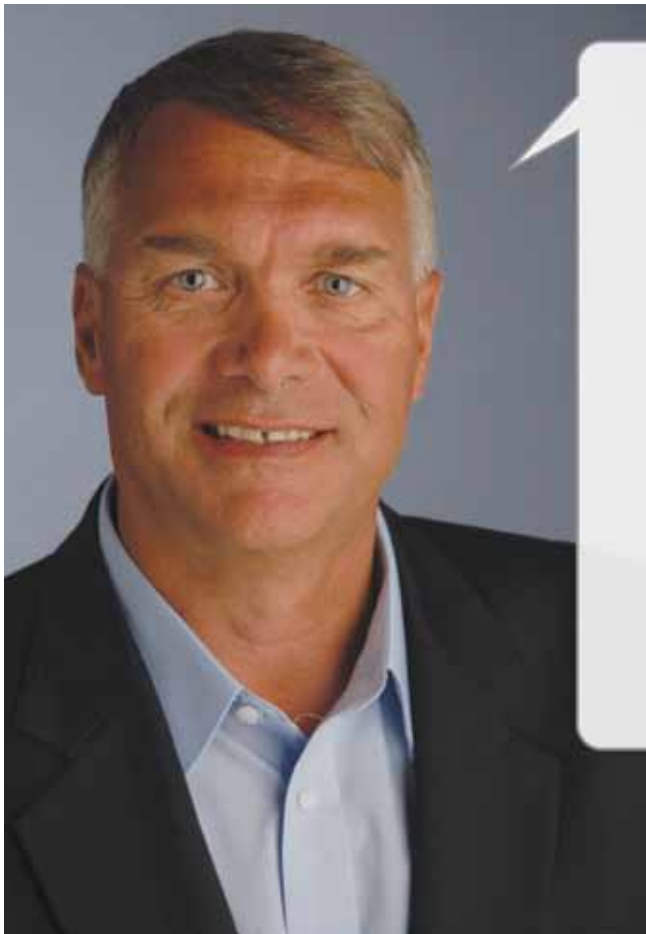
The software also offers a sand core simulation suite that includes core shooting, core drying, core blowing and core gas defect prediction.

Software's Strengths: Flow 3-D's filling accuracy leads to accuracy of solidification by providing the correct thermal profile for solidification.

What's Unique: Treatment of flowing fluid surfaces is modeled using TruVof, a true implementation of the Volume-of-Fluid method and the fractional area volume obstacle representation (FAVOR) method.



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(231) 720-6245
to learn more.**

Dick Winsemius
Corporate Advisor, Powerit Solutions
Former plant engineering manager and
foundry veteran of 30 years

 **Powerit Solutions**
www.poweritsolutions.com

CAP

EKK Inc.

37682 Enterprise Court
Farmington Hills, MI 48331
Tel: 248/624-9957
Website: www.ekkinc.com
Email: ekk@ekkinc.com

Entry Price Point: \$18,000 for an annual lease or \$45,000 to purchase the basic CAP sand package for meshing, fluid flow and solidification modeling of sand cast processes.

Overview: CAP is based on the 3-D finite element method. Its automatic CAP Smart Mesh Generator creates casting geometry with fine elements and modeled mold components with coarse elements. Smart Mesh technology minimizes the computer resources necessary to simulate real world processes. The same mesh can be used with all CAP components. Set up, execution and review of all CAP simulations are graphical user interface-driven.

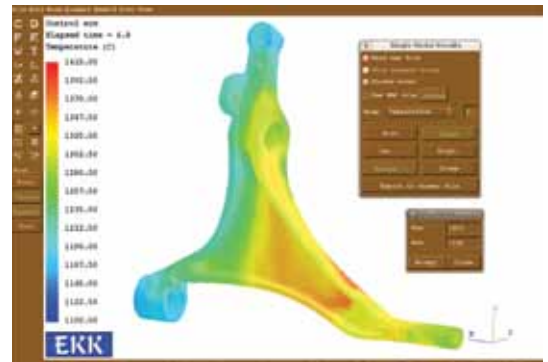
Newest Features: A significant

portion of improvements center around automating or semi-automating tasks commonly performed, such as mesh generation, simulation parameter setup, and macros for post-processing. The most recent improvement is automatically running sequential analysis with CAP Commander, a tool ideal for simulation design of experiment. It can execute a set of simulations sequentially with minimal user interventions. In the analysis software, EKK has added the ability to evaluate the effects of porosity of hydrogen gas concentration in the melt, as well as trapped air distributions from the flow analysis.

Software's Strengths: CAP originally was developed for high pressure diecasting, but it can model any mold material and casting process, including sand, semi- and low pressure permanent mold, squeeze and

investment casting. Aluminum, iron, magnesium and zinc are the most common alloys.

What's Unique: CAP generates full multi-component finite element meshes of the complete casting process in minutes, if not seconds. For high pressure diecasting, CAP models the liquid movement in the shot sleeve and the effects of intensification pressure on microporosity. Recently, the software has successfully predicted thermal cracks in castings.



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sales@flow3d.com

AnyCasting

AnyCasting Co. Ltd.

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157-779 Seoul, Korea

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Email: sales@anycasting.com

Entry Price Point: \$70,000-80,000, depending on casting process and modules chosen.

Overview: AnyCasting enables the user to simulate and analyze the total casting process, including 3-D mold filling, heat/solidification, 3-D thermal stress, microstructure and mechanical properties. It consists of anyPRE (geometry and mesh generation simulation control), anyDBASE (material and HTC database), anySOLVER (flow and solidification solver) and anyPOST (post processor) and batch-runner. Its mesh generation method produces 20 million meshes in five seconds. Users can trace the filling sequence for air entrapment,

oxides, mold erosion and vacuum and back pressure.

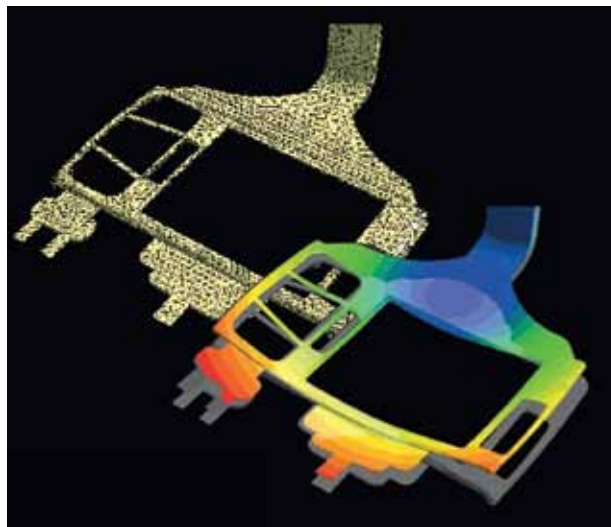
Newest Features: Real Flow technology boosts accuracy and speed using porous media and cut-cell methods. AnyCasting Co. also is enhancing the cast iron module to predict defects more accurately.

Software's

Strengths: AnyCasting Co. is geared toward sand, permanent mold and die casting users. Various shrinkage models for each alloy and casting process are available. The shot/sleeve module allows users to optimize sleeve condition, as well as modify the shot condition in high pressure diecasting. For high vacuum diecasting, users can predict the fluid

flow and air entrapment by considering the vacuum degree, sleeve and air gap of parting line/vent.

What's Unique: AnyCasting is MS-Windows-based and does not require a simulation specialist to use the software effectively. **MC**



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