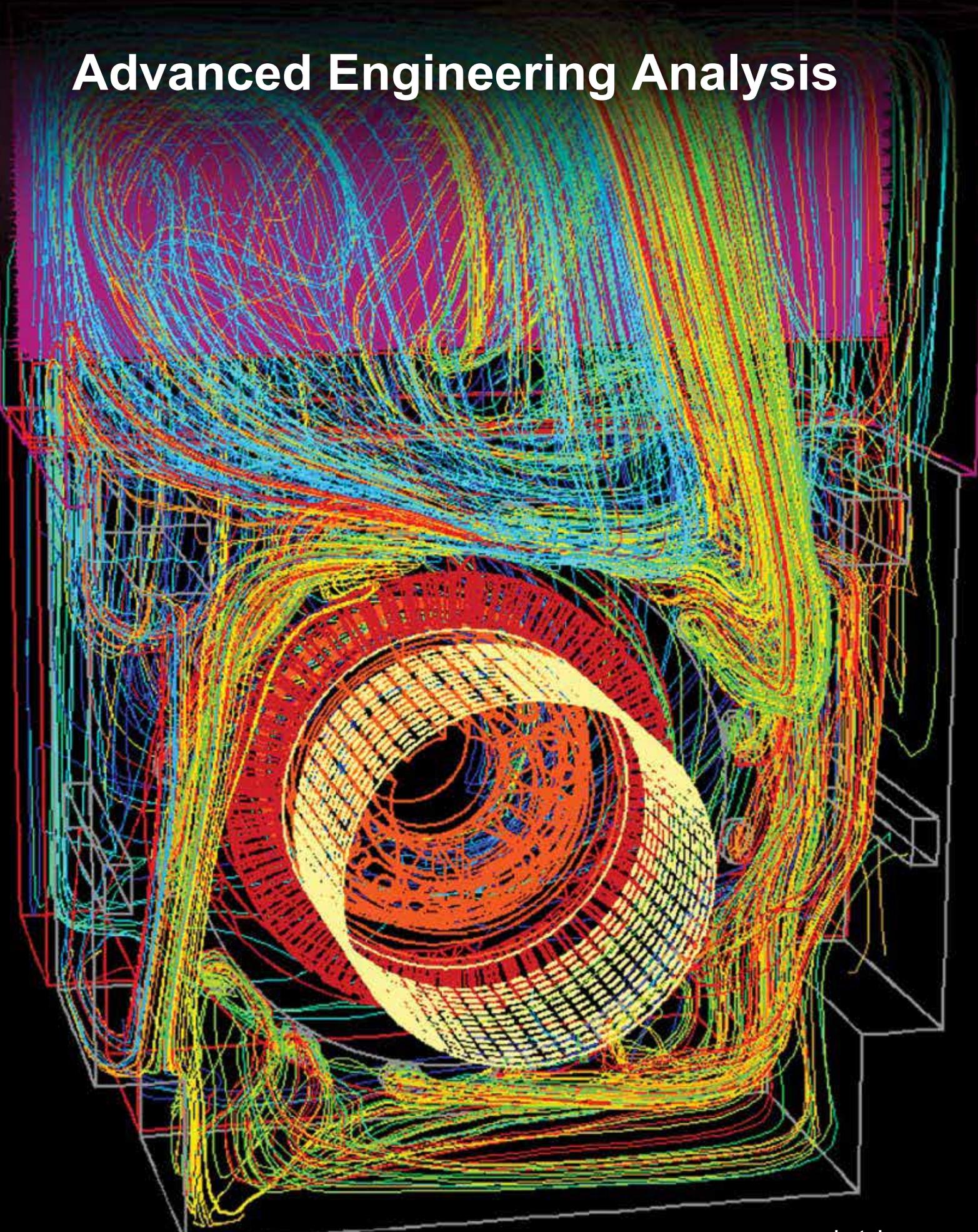




Advanced Engineering Analysis



Advanced Engineering Analysis

Real world problems are seldom simple. More often they involve many processes with dynamic and nonlinear phenomena. While in many situations a carefully selected simple analysis may yield great insight into a problem, to fully optimize a design or process or to explore an opportunity not seen by others, usually requires an advanced analysis. For capital intensive plant with high downtime costs, "trial and error" is not an option.

BMT WBM has a proven track record when it comes to accurately modelling complex engineering problems.

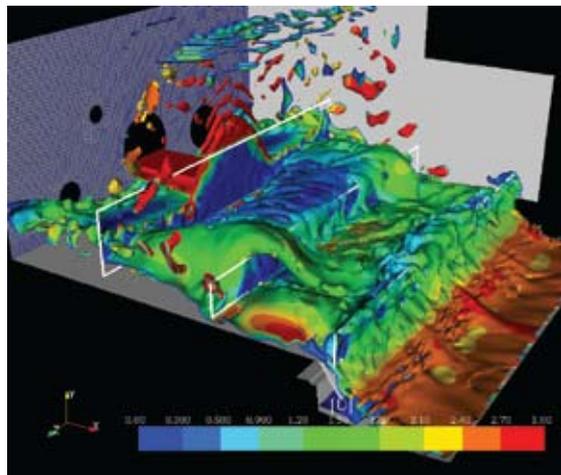
Complex models

Nearly every real world problem is complex, and in many cases simplifications will seriously detract from the usefulness of the model. As an example of the level of model complexity we deal with, BMT WBM has been developing Computational Fluid Dynamics (CFD) code to calculate the dynamic evolution and suppression of dust explosions. The software models compressible transonic flow with multiple gas species, lagrangian particle tracking with two way coupling of momentum and enthalpy between gas and particles, chemical kinetics, particle-gas mass coupling, particle-gas surface reactions and last but not least thermal radiation.

Coupled Co-Simulations

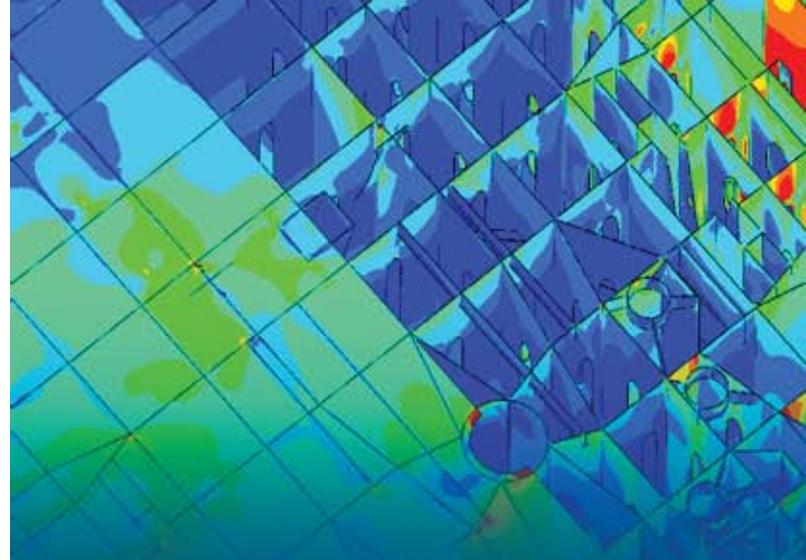
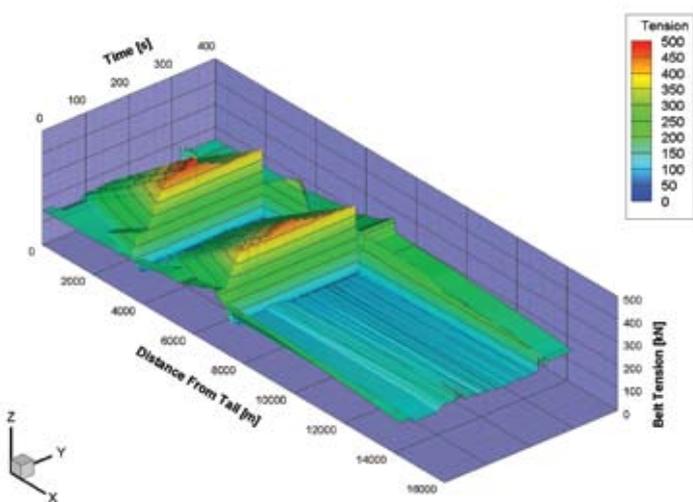
Often it is not possible to model the necessary scope of a problem within one software package. In such cases two or more software packages must be connected together with an appropriate data transfer interface. By way of example BMT WBM has recently developed a high fidelity model of a dragline. Three distinct models were required: a dynamic nonlinear finite element model of the machine's structure, an electro-mechanical model of the winch motors and machinery, and a software model of the PLC control system. The first of these models was solved within LS-Dyna, and the latter two models solved in Matlab Simulink. The two disparate packages were linked with in-house software and the fully coupled structural-electrical-control model developed and calibrated.

Another example of coupled co-simulations is where a conveyor transfer station was modeled using EDEM coupled with Fluent – the former computed the bulk material flow and the latter computed the air and dust flow.



Model Calibration

Model calibration against available data is an essential step in the process of developing novel and complex models. The process is often exacerbated by the numerous model input parameters and a lack of available data by which model components may be individually tested. In some cases the solution has been to gather field test data from the target system under carefully constructed test conditions. In other cases calibration data can be gleaned from previous test results. Either way, as large complex models usually required a number of hours to run on multi-core computers, the calibration process must be driven by someone who has an intimate understanding of the model physics and who fully appreciates the purpose of the model.



In-house Software

BMT WBM has developed in-house software capability in two key areas – conveyor dynamics and Discrete Element Modelling (DEM).

The dynamics of long conveyor systems are highly nonlinear and not well understood except by numerical simulation. WBM's "BelSim" has been carefully developed over a number of years to accurately model conveyor dynamics and to provide an essential tool for both upfront design and trouble shooting of conveyor systems.

In response to growing demand for Discrete Element modeling for bulk material handling problems, BMT WBM has developed its own in-house code "SAND". While commercial DEM software is available, developing our own software has yielded an intimate appreciation of the application (and limitation) of the Discrete Element Method. SAND has been effectively used to model "hang-up" of cohesive bulk materials and provide insight into how to design storage facilities for such materials.

Software Partnering

Cutting edge models of complex systems usually lie at the edge of, or even beyond, the capability of commercially available software. In this situation BMT WBM has either had to write customised plug-in modules for the commercial code, or else develop an extended capability for the software in partnership with the software source developer. The latter approach has proven to work for the mutual benefit both parties, with an excellent example being the development, testing, and calibration of coal dust combustion libraries for the OpenFOAM (open source) CFD toolkit.



BMT WBM has a proven record in addressing today's engineering and environmental issues.

We aim to continue to enhance our services, capabilities and areas of application to meet the community's future development and environmental protection needs.

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