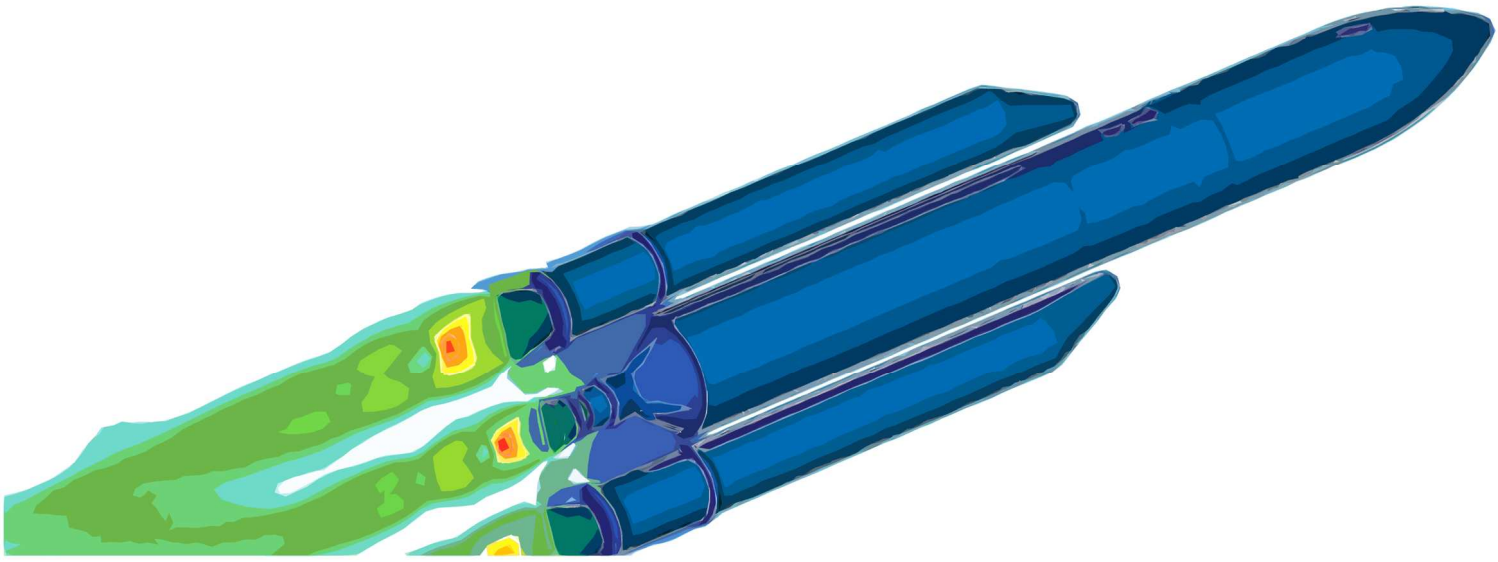
ZEUSNUMERIX



QUARTERLY NEWSLETTER

Q1, 2012 | Zeus Numerix

www.zeusnumerix.com

Message from the Chairman

Dear Friends,

In the Financial Year 2011-12, Zeus Numerix (ZN) has surpassed its own expectations in the: Development of New Products and Technology; Supply of high value Project Deliverables in Defense and Nuclear Area; and in earning a record Revenue.

The new Products and Technology developed are:

1. Store Separation in Military Aircraft; and Stage Separation in Spacecraft (Aerospace Industry).
2. Thermal-Hydraulic Simulation of Blockage in a Fast-Breeder Reactor (Nuclear Industry).
3. Analysis of Surge during flow through pipes (Piping Industry).
4. Structural Integrity of Aerospace and Naval Structure (Space Establishment).
5. Electromagnetics of Antenna, Radars, & Stealth (Defense Industry).

In FY 2011-12, ZN's Project Teams have indigenized several technologies and added 15 new Customers in a wide range of areas: Missile Design to Sugar Manufacturing – in order to develop new products.

ZN is now organized: to develop not merely new Software Products; but extend this development capability to produce an Optimized Design for novel application. Further, based on its Design, ZN organized the fabrication of sophisticated engineering hardware products and then evaluate and demonstrate – its expected performance. Thus, ZN now covers the entire development space: from concept to commissioning.

We keenly look forward to engage and join our customers to partner – the development of new engineering software and hardware products.

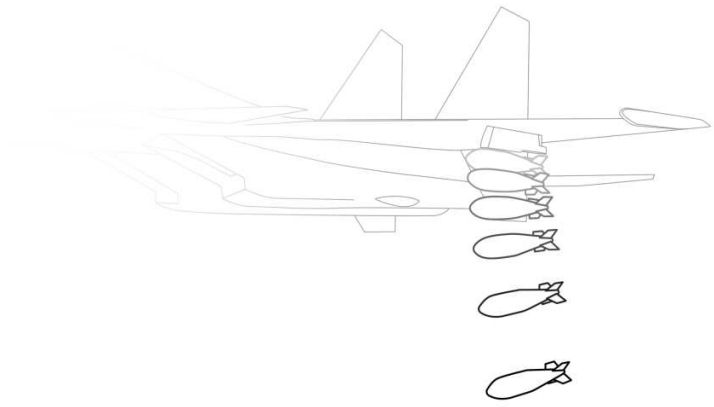
S. Banerjee
Chairman,
Zeus Numerix Pvt. Ltd.

Aerospace & Defense	Engineering Services	Computational Fluid Dynamics

Trajectory Prediction of Store Separating from Aircraft

Our customer is an establishment that evaluates aircrafts and systems for induction into services. An important aspect of integrating a jettison-able store is its ability to separate safely when released from parent aircraft. Ensuring a safe separation requires precise estimation of trajectory of the store under actual flight conditions. Wind tunnel experiments cannot generate these trajectories due to dynamic nature and carrying out flight tests without estimating separation behavior is dangerous.

Zeus Numerix carried out CFD simulations to compute time accurate trajectories of stores using proprietary solver comprising of automated pre-processor, implicit compressible CFD solver and 6-DoF dynamics solver. The methodology was validated against trajectory data of a store from actual flight test. The analysis was carried out for 2 new low drag stores under investigation with the help of a simulation matrix. The simulation matrix was designed in a way to understand the effect of altitude, Mach number, angle of attack and side slip angle on the separation behavior of new stores.



The customer was provided with detailed analysis of the vital dynamics parameters that ensured the safe separation of the stores. Extremely critical trends were obtained that established the relation between safe separation & flight conditions. Subsequently, the customer used this study to obtain certification & approval for integrating the stores with the aircraft.

Aerospace & Defense	Customized CAE Software	Control & Dynamics

Software for Preliminary Design of Solid Propellant Rocket

Quick performance analysis of design of slender body projectiles in particular, rocket and missile is a primary requirement for our customer in defense industry. Aerodynamic calculations and structural estimation is the starting step in the design cycle. At present, two approaches for aerodynamic calculation, namely wind-tunnel tests and CFD, are available at client's disposal, but both of these methods are expensive and time consuming. Theoretical prediction of aerodynamic performance comes as an alternate to save time and money.

Zeus Numerix developed a customized software, which has four modules namely: Aerodynamic, Structural, Internal Ballistics & Dynamics integrated through a common user interface. The Aerodynamic module was purely based on empirical relations. The structural module estimates the inertial properties of various components of the rocket. The internal ballistics tool produces the pressure-time curves for finocyl grain configuration. The dynamics module uses the outputs from the other three modules and predicts the max range and velocity profile.

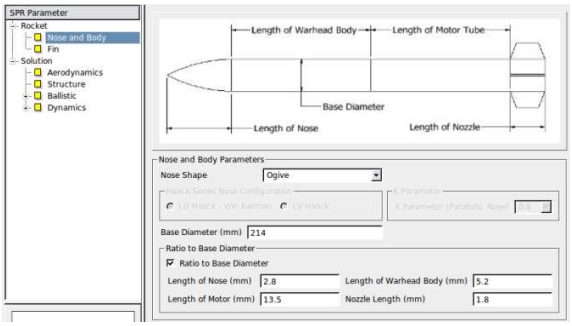


Illustration 1: Snap shot of rocket design software

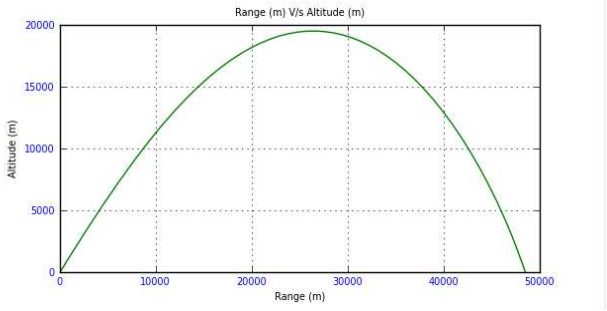


Illustration 2: Predicted range and velocity profile

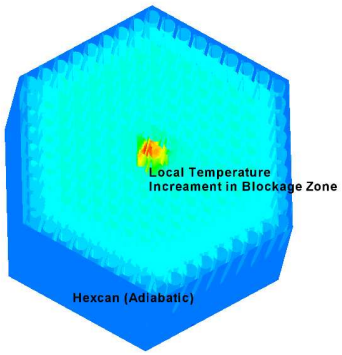
The customer was provided with the customized software. It is a GUI driven software which a designer can use to produce preliminary design for solid propellant rockets. The software has now become an integrated part of the design process of a solid propellant rocket.

Nuclear Power & Energy	Customized CAE Software	Computational Fluid Dynamics

Characterization of Blockages in Nuclear Fuel Pin Bundle

Our customer is the nodal atomic energy center for design and development of Fast Breeder Reactors. It is a Sodium cooled pool type reactor where heat is generated in the fuel subassemblies, each comprising of 217 tightly packed fuel pins. Solid impurities, if any are present, in the Sodium pool can lead to local blockages in fuel pin bundle which may cause flow disruption, boiling of Sodium or melting of fuel pins. Analysis of such event by experiment is practically infeasible; moreover, typical sub-channel empirical codes are not applicable for pin bundles with blockage

Zeus Numerix simulated subassembly blockage event using full scale CFD approach, in the process, overcoming major hurdles of complex mesh generation, & massively scalable solver. Zeus Numerix used proprietary software GridZ™ to create very unique structured mesh around wire wrapped fuel pin bundle. Blockages were modeled as porous zone. Its proprietary solver completed one simulation of 35 million grids in less than 10 hours on 84 cores computing cluster.



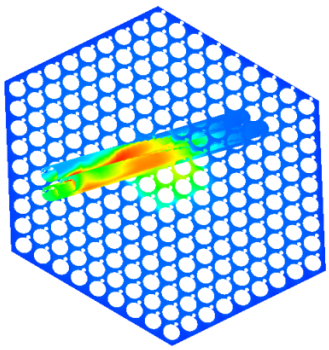


Illustration 1: Increase in Sodium Temperature in Blockage

Illustration 2: Blockage Hot Spots on Pin Clad

The proprietary simulation setup was commissioned at customer's premises. Parametric studies were done for understanding the effect of size, shape & location of blockages. It established the relation between blockage size, reduction in flow & local hot spots. Thus, a major safety & regulatory requirement was met. To best of customer's knowledge, it is the first instance in this global nuclear community that full scale fuel subassemblies were simulated with such details.

Aerospace & Defense	Engg. Software Development	Electro Magnetism

Computation of Scattering Parameters of Radar Absorbent Material

Our customer is a premier defense establishment involved in the development of stealth technology which aims at reducing radar cross section (RCS) of military vehicles and projectiles. An effective way to reduce RCS is by applying coatings of radar absorbent material (RAM) on the surface of vehicle. The RAM coatings could be composed of a single material or a composite mixture for enhanced capabilities. To design these coatings efficiently, their behavior needs to be understood in terms of their scattering parameters.

Zeus Numerix utilized edge based Finite Element Method to develop a generic electromagnetic field solver. Using this solver, scattering parameters of a RAM placed in a waveguide were computed for various frequencies of incident electromagnetic waves. The solver uses unstructured meshes with tetrahedral cells and solves the linear system of equations to obtain electric fields at the edges of the tetrahedrons. The field values are then used to calculate the reflection and transmission coefficient which are then used to compute S-parameters. Zeus Numerix also developed an analytical tool to compute effective electrical permittivity and magnetic permeability of a composite mixture material from the microstructure of the base material and randomly distributed fillers.

The client was provided with the generic software which takes geometrical and electromagnetic properties of the material as inputs and computes its S-parameters. They used the software to study various types of material and composites to design the most effective coating for reducing RCS. This significantly saves time and cost earlier required in analyzing various coatings using experiments.

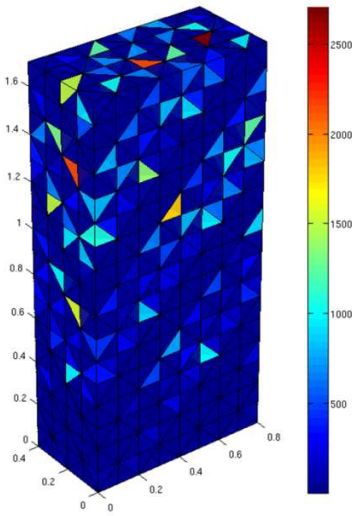


Illustration 1: Cell centered electric field intensities

Industrial & Fluid Machinery	Engineering Services	Electro-Magnetism

Simulation of Induction Heating Furnace

Our customer belongs to the R&D division of a Fortune 500 company that is focused towards design and performance optimization of Induction Heating Furnace. This furnace uses concentric circular coils to generate magnetic field and eddy currents for heating of metal in the crucible. A mathematical model of induction heating furnace was sought by customer to help him analyze the distribution of heat generation and temperature.

Zeus Numerix developed a specialized & custom tool for simulation of furnace based on solution of Maxwell's equations. A 2-D finite volume time domain technique was used to simulate the problem and to determine the vector potential distribution in the domain. The problem was simulated at GHz frequencies and a current of kA magnitude was passed through the coils as input. The tool simulated magnetic field, induced currents &heat generation inside the furnace.

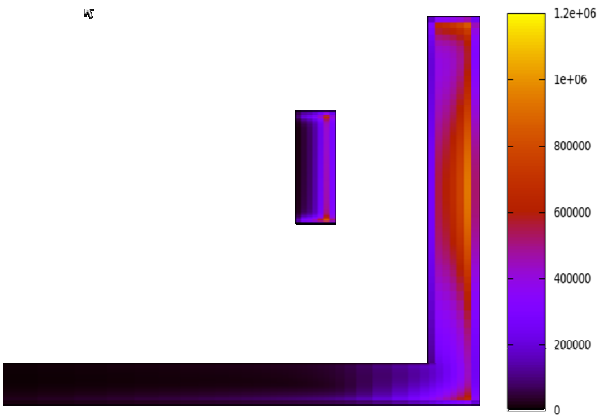


Illustration 1: Distribution of Power in Induction Heating Furnace

The customer was delivered with the power and current distribution in the furnace. It was found that the maximum power dissipated was in the heater, which was expected. The customer used the power dissipation output to estimate temperature distribution & benchmarking of simulation model with experimental observation.

Industrial & Fluid Machinery	Engineering Services	Structural Analysis

Structural Analysis of Retractable Platform

Our customer is involved in design and erections of marine structures and equipments. Structural failure was occurring on a retractable platform which was erected on a ship. Our client wished to revisit their design before modification of the structure by doing a thorough FEA simulation. The customer was interested in finding the failure regions and solutions to avoid these failures.

Zeus Numerix performed structural analysis of the retractable platform for different configurations of the platform; in its extracted position or retracted position. The wheel that assists for the movement of the platform on the girder was also checked for structural integrity. Simulations were done to find the Von-Mises stress and deformation in the structure. High stress region on the structure were marked for potential failure of the structure. An analysis based design approach was followed to find the solution for reducing high stress and thus avoiding future failures.

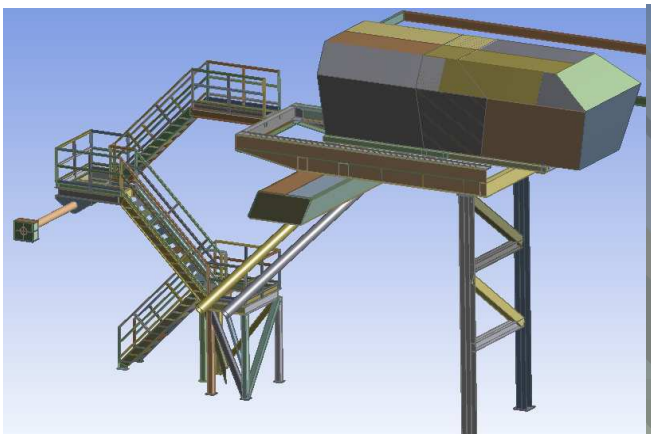


Illustration 1: Retractable Platform on Ship

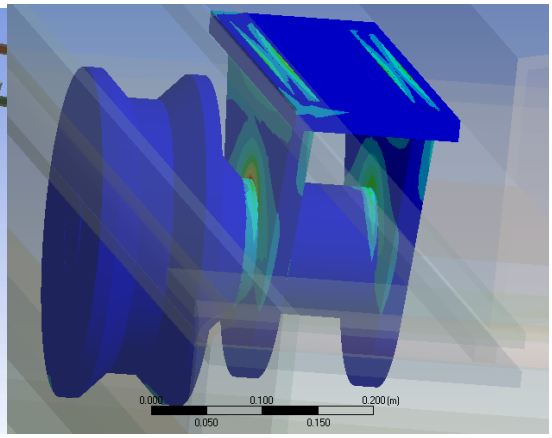


Illustration 2: Stresses on Wheel & Girder

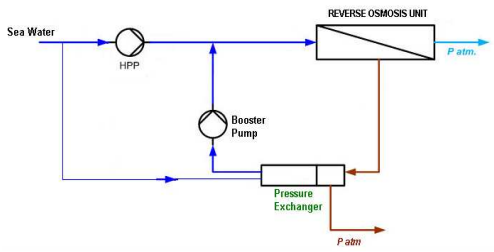
Customer was provided with deflection plots for the structure and the Von-Mises stress distribution. Failure zones were marked. Appropriate strengthening of structures was suggested to avoid the failure of the structure and maintain its structural integrity. During the period, Zeus Numerix team worked as an extended off-shore center dedicated to the customer offering substantial time & cost benefits.

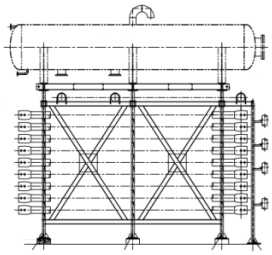
Construction & Infrastructure	Engineering Services	CFD/Structural Analysis

Surge Analysis of High Pressure Pipes in Desalination Plant

Our customer is a leader in water and waste water management solutions to the industry. They are engaged in design and construction of 100 MLD desalination plant. One of the focus areas is finalizing the high pressure pipe layout and gaining confidence on the associated support structure. Such pipe layout and associated skid are under constant threat of damage due to water hammer i.e. surge load that arises from sudden pump failure or valve closure. Since the length of high pressure pipes in plant were unusually long, the surge load was expected to be severe. It estimation was not possible using any thumb rule or empirical relationship

Zeus Numerix performed surge analysis for obtaining surge pressure loads followed by structural analysis of skid for ensuring its survival during such event. Surge analysis was performed using 1D fluid mechanics formulations. The physics involved transient movement of pressure waves in pipe during sudden changes in operating conditions. Various scenarios such as sudden pump closure and valve closure were studied for the surge analysis. Static and dynamic structural analysis of the skid was carried out against the loads obtained from the surge study.





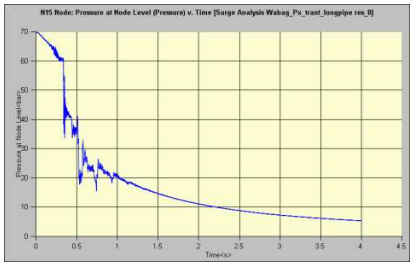


Illustration 1: Schematic of Plant *Illustration 2: RO Skid Design* *Illustration 3: Pressure Surge*

Customer was provided with magnitude of surge pressures in pipes and the von-Mises stress distribution for the skid. Through this study, our customer was assured that the structural design of pipe supports & RO skid were strong enough to withstand the impact of surge during power failure or sudden valve closure. This study is turned out to be crucial considering its importance towards reliable operation of large capacity desalination plant.

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