

# CONFERENCE AGENDA

Parkhotel Schönbrunn | Vienna, Austria  
06-10 March, 2017



# CONVERGE

USER CONFERENCE  
— EUROPE 2017 —

TRAINING

LEARNING

NETWORKING

# WELCOME

**WELCOME** to the 2017 CONVERGE European User Conference! You, our CONVERGE users, encouraged us to have a conference here in Europe, and we thank you for doing so.

This conference will feature speakers and attendees from Europe and around the globe. Reacting flows are the heart of what we do, and we are pleased to offer many engine-related presentations, including keynotes by research leaders from GE Power, IFP Energies nouvelles, and Argonne National Laboratory. In addition to engine simulations, however, CONVERGE's truly unique CFD approach is applicable to a wide variety of flow problems. This conference also includes presentations on diverse topics including pumps and compressors, gas turbines, aftertreatment systems, and fuel injectors.

While we call this event our "User Conference," you're much more than just a CONVERGE user. We believe that each of you is a collaborator, inspiring us to continue to push the limits in a way that best meets your CFD needs.

As a way of saying thank you, our goal is to offer a unique, informative, and enjoyable conference. In keeping with CONVERGE UC tradition, we are pleased to offer free training courses before and after the conference. During the conference itself we have a variety of daytime and evening events so that you can network with colleagues from around the world and experience the city of Vienna with a visit to Castle Schönbrunn and the traditional Austrian Heurigen Night.

Thank you to all of our speakers for sharing your expertise with the CONVERGE community. Thank you to this year's sponsors—we encourage you to visit their displays to learn more about their exciting products. On behalf of everyone at Convergent Science, thank you for attending our first-ever European conference and we hope you enjoy the week.



**RAINER ROTHBAUER**  
Co-Owner & General Manager  
*Convergent Science GmbH*



## CONFERENCE SCHEDULE AT A GLANCE

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### DAY

### EVENING

**MONDAY** 06 MARCH

Introductory + Advanced  
**CONVERGE** Training  
Parkhotel Schönbrunn

**TUESDAY** 07 MARCH

Advanced **CONVERGE** Training  
Parkhotel Schönbrunn

Welcome Reception  
Parkhotel Schönbrunn  
Gloriette Bar

**WEDNESDAY** 08 MARCH

Welcome + Presentations  
Parkhotel Schönbrunn  
Grand Ballroom

Grand Tour + Dinner  
Castle Schönbrunn

**THURSDAY** 09 MARCH

Presentations  
Parkhotel Schönbrunn  
Grand Ballroom

Heurigen Night  
Werner Welsler Heuriger

**FRIDAY** 10 MARCH

Advanced **CONVERGE** Training  
Parkhotel Schönbrunn

# KEYNOTE SPEAKERS



## **DR. ANDREAS M. LIPPERT**

Executive Engineering Leader  
*Distributed Power*  
*GE Power*

### **MULTI-PHYSICS SIMULATION IS JUST THE BEGINNING IN A DIGITAL INDUSTRIAL ENTERPRISE**

08:45–09:25, **Wednesday** 08 March

Dr. Lippert is the Executive Engineering Leader for GE's Distributed Power business headquartered in Jenbach, Austria. Distributed Power is focused on power generation and gas compression at or near the point of use with a product portfolio that includes highly efficient industrial reciprocating engines that generate 200 kW to 10 MW of power for numerous industries globally.

As Engineering Leader, Dr. Lippert heads product and technology development, balance-of-plant application engineering and order fulfillment across gas and diesel engines, as well as component and systems development at global engineering sites. Dr. Lippert has more than 20 years of experience in product and technology development and in leading multi-disciplinary teams in strategic and technology functions. He won a GE Power & Water leadership award in 2015 for advancing key new product introductions.

Dr. Lippert has bachelor's and master's degrees in mechanical engineering from the University of Pretoria, South Africa. He obtained his Ph.D. in mechanical engineering from the University of Wisconsin-Madison, from which he also received the College of Engineering's Early-Career Achievement Award in 2009.



## **DR. SIBENDU SOM**

Lead Computational Scientist  
*Argonne National Laboratory*

### **HIGH-FIDELITY SIMULATIONS FOR CO-OPTIMIZATION OF ENGINES AND FUELS & HIGH THROUGHPUT CALCULATIONS ON SUPERCOMPUTERS**

15:15–15:55, **Wednesday** 08 March

Dr. Sibendu Som leads a CFD team of 10 researchers at Argonne National Laboratory with research focus on the development of nozzle-flow, spray, and combustion models and HPC for ICE applications. His team is responsible for developing predictive simulation capabilities for OEMs to develop advanced high-efficiency, low-emission engines. Dr. Som's group is pioneering the implementation of uncertainty quantification for engine simulations. He is a co-founder and technical lead on Argonne's Virtual Engine Research Institute and Fuels Initiative (VERIFI) program, which is aimed at providing predictive simulations for OEMs.

Dr. Som received his Ph.D. in Mechanical Engineering from University of Illinois at Chicago in 2009. He is a Computational Fellow at University of Chicago. Dr. Som is the recipient of the prestigious HPC Innovation Excellence Award by IDC in 2014, the Federal Laboratory Consortium Award for Excellence in Technology transfer by DOE in 2015, and the Best Postdoctoral Supervisor Award from Argonne in 2016. Dr. Som has authored more than 100 papers, with more than 50 each in journals and peer-reviewed conference publications. His papers have more than 1900 citations.



**DR. CHRISTIAN ANGELBERGER**  
Expert  
*Engine and Vehicle Systems Division*  
*IFP Energies nouvelles*

**LARGE-EDDY SIMULATION FOR  
INTERNAL COMBUSTION ENGINES:  
STATE-OF-THE-ART AND TRENDS**

08:45–09:25, Thursday 09 March

After receiving an engineering diploma in aeronautics from Stuttgart University (Germany) in 1993, Dr. Angelberger received his Ph.D. in Fluid Mechanics from Toulouse University (France) in 1997. His major field of expertise is the development and application of Large-Eddy Simulation (LES) to combustion engines. He actively participated in the development of the well-known AVBP code during his postdoctorate at CERFACS.

Dr. Angelberger's work with AVBP included the very first applications of LES to combustion instabilities in gas turbines. Since 1999, he has been employed in IFP Energies nouvelles' Powertrain and Vehicle Division. He initiated a number of breakthrough studies concerning the application of LES to non-cyclic phenomena in piston engines and has organized the LES4ICE conference since 2008.

# PRESENTATION SCHEDULE

## WEDNESDAY 08 MARCH

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07:00	Registration Opens
07:30-08:30	Breakfast
08:30-08:45	<b>WELCOME</b>   Kelly Senecal & Rainer Rothbauer   <i>Convergent Science</i>
08:45-09:25	<b>KEYNOTE</b>   Multi-Physics Simulation is Just the Beginning in a Digital Industrial Enterprise Andreas Lippert   <i>GE Power</i>
09:25-09:50	<b>Injector Flow and Near-Nozzle Eulerian Spray Simulations</b> Michele Battistoni   <i>University of Perugia</i>
09:50-10:15	<b>Spray Calibration and Combustion Simulation for Large Bore Engines Using CONVERGE</b>   Avnish Dhongde   <i>FEV</i>
10:15-10:30	<b>SPONSOR</b>   Gamma Technologies
10:30-11:00	Break
11:00-11:25	<b>Simulation of Diesel Spray Using an Improved Version of TKI-ECFM3Z</b> Jean-Baptiste Michel   <i>IFP Energies nouvelles</i>
11:25-11:50	<b>Implementation of a Spray Combustion Model and a Combustion Optimization System</b>   Ricardo Novella   <i>CMT-Motores Térmicos</i>

11:50–12:15

**Necessary Grid Resolution and Turbulence-Chemistry Interaction Modeling**

Corinna Netzer | *Brandenburg University of Technology Cottbus*

12:15–13:15

**Lunch**

13:15–13:40

**Predictive Urea Deposit Simulations with CONVERGE**

Scott Drennan | *Convergent Science*

13:40–13:55

**SPONSOR** | SES-Tec

13:55–14:20

**Application of Particle Sectional Model for Soot Modeling in Diesel Engines**

Rathinam Balamurugan | *Renault*

14:20–14:45

**Combustion Process Optimization for an EGR Only Offroad Diesel Engine**

Federico Millo | *Politecnico di Torino*

14:45–15:15

**Break**

15:15–15:55

**KEYNOTE | High-Fidelity Simulations for Co-Optimization of Engines and Fuels & High Throughput Calculations on Supercomputers**

Sibendu Som | *Argonne National Laboratory*

15:55–16:20

**Gas Turbine Combustor Modeling with CONVERGE**

Daniel Lee | *Convergent Science*

16:20–16:35

**SPONSOR** | Rescale

16:35–17:00

**Large Eddy Simulation Modeling in CONVERGE**

Eric Pomraning | *Convergent Science*

# PRESENTATION SCHEDULE

## THURSDAY 09 MARCH

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07:00  
07:30-08:30

**Registration**  
**Breakfast**

08:30-08:45

**WELCOME BACK** | Robert Kaczmarek | *Convergent Science*

08:45-09:25

**KEYNOTE** | **Large Eddy Simulation for Internal Combustion Engines: State-of-the-Art and Trends**  
Christian Angelberger | *IFP Energies nouvelles*

09:25-09:50

**Modeling and Understanding Cycle-to-Cycle Variation Through Multi-Cycle LES** | Mohsen Mirzaeian | *Politecnico di Torino*

09:50-10:15

**Efficient Optimization for Engine Combustion Chamber Design**  
Clément Dumand | *Groupe PSA*

10:15-10:30

**SPONSOR** | BETA CAE Systems

10:30-11:00

**Break**

11:00-11:25

**Numerical Simulation of a Lean-Burn NG Engine Using a PaSR Combustion Model** | Lorenzo Bartolucci | *University of Rome Tor Vergata*

11:25-11:50

**SI Engine Simulation Using ECFM-ISSIM Model with CONVERGE 2.3**  
Stéphane Chevillard | *IFP Energies nouvelles*



11:50–12:15	<b>Evaluation of SI Combustion Models: Knock with EGR and Water Injection Effects</b>   Michele Battistoni   <i>University of Perugia</i>
12:15–13:15	<b>Lunch</b>
13:15–13:40	<b>Modeling Flows in Complex Moving Geometries of Pumps &amp; Compressors</b> David Rowinski   <i>Convergent Science</i>
13:40–13:55	<b>SPONSOR</b>   Friendship Systems
13:55–14:20	<b>Methodology for Simulation of Engine Structure Temperature and Its Validation</b>   Aris Babajimopoulos   <i>Volvo Cars Corporation</i>
14:20–14:45	<b>Kinetic Modeling of SI Engine Combustion—Opportunities and Challenges</b> Max Mally   <i>RWTH Aachen University-Institute for Combustion Engines</i>
14:45–15:15	<b>Break</b>
15:15–15:40	<b>The Computational Chemistry Consortium and the Importance of Detailed Kinetics in Combustion Simulations</b>   Henry Curran   <i>Computational Chemistry Consortium</i>
15:40–15:55	<b>SPONSOR</b>   EnSight
15:55–16:20	<b>Approach of Reviving the Rotary Engine through the Use of Kerosene with the Help of CFD and Chemical Kinetic-Reaction Simulation</b> Felix Zahradnik   <i>Vienna University of Technology</i>
16:20–16:45	<b>New Features in CONVERGE Version 2.4 and a Sneak Peek at 3.0</b> Keith Richards   <i>Convergent Science</i>
16:45–17:00	<b>CLOSING</b>   Kelly Senecal   <i>Convergent Science</i>

# TRAINING SCHEDULE

## MONDAY 06 MARCH

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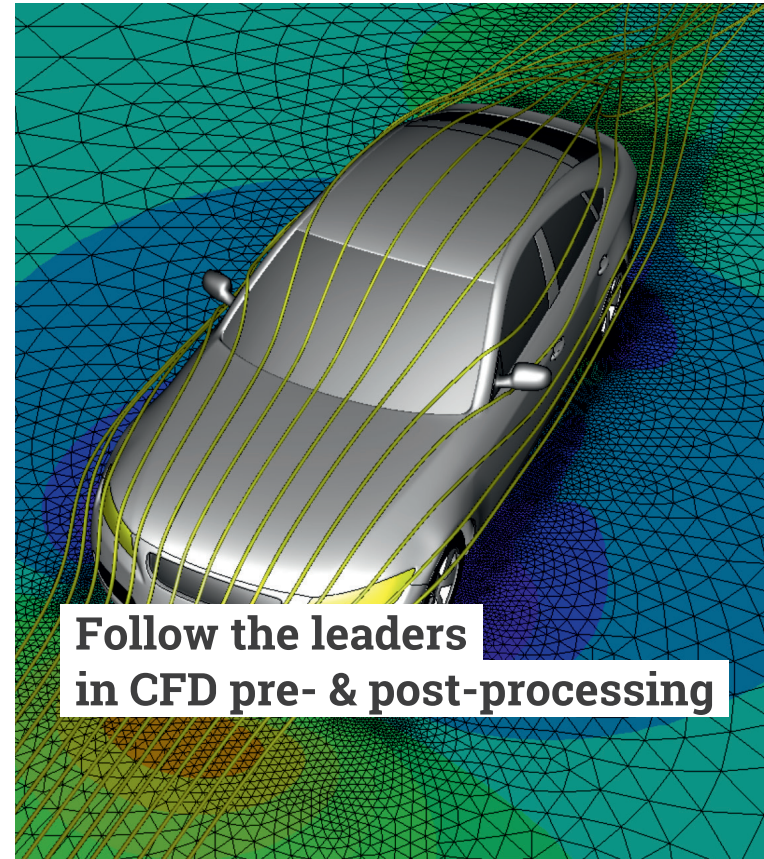
07:15	Registration
07:30-08:00	Light Breakfast
08:00-12:00	<b>IC Engine Modeling with CONVERGE</b> <i>Seminar Suite 1222</i>
08:00-10:00	<b>User-Defined Functions</b> <i>Franz Josef Hall</i>
10:00-12:00	<b>Tools for SAGE Detailed Chemistry</b> <i>Franz Josef Hall</i>
12:00-13:00	Lunch
13:00-17:00	<b>IC Engine Modeling with CONVERGE, continued</b> <i>Seminar Suite 1222</i>
13:00-15:00	<b>Advanced Emissions Modeling</b> <i>Franz Josef Hall</i>
15:00-17:00	<b>Volume of Fluid Modeling</b> <i>Franz Josef Hall</i>

## TUESDAY 07 MARCH

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07:15	Registration
07:30-08:00	Light Breakfast
08:00-12:00	<b>Engine Aftertreatment Modeling</b> <i>Seminar Suite 1222</i>
08:00-10:00	<b>Advanced Spray Modeling</b> <i>Franz Josef Hall</i>
10:00-12:00	<b>Advanced Turbulence Modeling</b> <i>Franz Josef Hall</i>
12:00-13:00	Lunch
13:00-17:00	<b>Advanced Topics in IC Engine Modeling</b> <i>Seminar Suite 1222</i>
13:00-17:00	<b>Advanced Combustion Modeling</b> <i>Franz Josef Hall</i>

07:30-08:00	Light Breakfast
08:00-12:00	<b>Advanced CHT Modeling</b> <i>Franz Josef Hall</i>
08:00-09:30	<b>Advanced Fluid-Structure Interaction Modeling</b> <i>Seminar Suite 1222</i>
10:00-11:00	<b>CONVERGE-GT SUITE Coupling</b> <i>Seminar Suite 1222</i>
11:00-11:30	<b>EnSight Workshop</b> <i>Seminar Suite 1222</i>
11:30-12:00	<b>Running CONVERGE in the Cloud with Rescale</b> <i>Seminar Suite 1222</i>
12:00-13:00	Lunch
13:00-17:00	<b>Gas Turbine Engine Combustion</b> <i>Franz Josef Hall</i>
13:00-15:00	<b>Advanced Sealing</b> <i>Seminar Suite 1222</i>
15:00-17:00	<b>Genetic Algorithm Optimization</b> <i>Seminar Suite 1222</i>



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in CFD pre- & post-processing**

# TRAINING DESCRIPTIONS

## MONDAY 6 MARCH

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### **INTERNAL COMBUSTION ENGINE MODELING WITH CONVERGE**

*08:00-17:00*

This course is the first day only of the two-day introductory training course Internal Combustion Engine Modeling in CONVERGE. You will learn about the CONVERGE workflow and the options for boundaries, regions, initialization, and grid control. During this course you will have time to practice setting up the boundaries and regions, as well as the initialization and grid control options, for a typical IC engine case in CONVERGE Studio. Note that this course will not include surface preparation or physical models for spray, combustion, turbulence, or other processes.

### **USER-DEFINED FUNCTIONS**

*08:00-10:00*

In this workshop we will explore the vast array of user-defined functions (UDFs) that can be used to adjust existing models, implement new models, direct CONVERGE to calculate additional quantities, or initialize or reinitialize physical variables. We will discuss the different types of UDFs that CONVERGE supports as well as the process of compiling the UDFs and the necessary header files.

### **TOOLS FOR SAGE DETAILED CHEMISTRY**

*10:00-12:00*

CONVERGE includes a variety of tools to complement the SAGE detailed chemistry solver. In this workshop we will discuss the zero-dimensional

ignition delay, mechanism reduction, one-dimensional laminar flame speed, and mechanism merge tools.

### **ADVANCED EMISSIONS MODELING**

*13:00-15:00*

CONVERGE contains two detailed soot models—particulate mimic (PM) and particulate size mimic (PSM). Although it is computationally expensive to run a three-dimensional simulation with a detailed soot model and the SAGE detailed chemistry solver, CONVERGE contains acceleration strategies to make it feasible to include detailed soot modeling in engine simulations.

In this workshop we will discuss the methodologies of these models, acceleration strategies for detailed soot modeling coupled with gas-phase chemistry, and the effects of important soot parameters. We will also discuss other

emissions models (e.g., NO<sub>x</sub>) and give recommendations for these models.

## VOLUME OF FLUID MODELING

15:00-17:00

Volume of fluid (VOF) methods are some of the most popular numerical techniques for locating moving and deforming interfaces between fluids in multiphase flow simulations. In this workshop, we will discuss numerical details, example cases, and some

validation calculations for the various VOF options in **CONVERGE**. One VOF method in **CONVERGE** is based on the species mass fraction equation and is appropriate for miscible or compressible multiphase flow calculations. Another VOF method, which solves for the void fraction directly, is available in **CONVERGE** as two separate schemes: Piecewise-Linear Interface Calculation (PLIC) and High-Resolution Interface-Capturing (HRIC). These schemes have been tested on a range of problems including a breaking dam, a rising droplet,

and spray injection, and each test case illustrates the ability of the method to track interfaces sharply.

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TUESDAY 7 MARCH

## ENGINE AFTERTREATMENT MODELING

08:00-12:00

This workshop will focus on Urea/SCR engine aftertreatment modeling

**Rescale** provides an industry-leading, high-security cloud simulation platform specifically designed for computer-aided engineering (CAE) simulation. With a focus on high-performance computing (HPC), enterprise companies can leverage **Rescale's** innovative platform solution to seamlessly execute complex simulations securely from anywhere in the world.

**Rescale** partners with leading software vendors to provide on-demand access to a variety of simulation packages, including **CONVERGE**, while simultaneously offering customizable HPC hardware. There are no job queues and large-scale capacity (10,000+ cores) is immediately configurable for a wide variety of simulation needs.

**Rescale's** holistic, dynamic platform-as-a-service (PaaS) integrates the CAE software, custom HPC hardware, leading security features, and collaborative analysis tools needed for enterprise companies to instantly accelerate their simulations.

[rescale.com](https://rescale.com)



in **CONVERGE**. We will discuss urea decomposition and hydrolysis to ammonia, and we will describe how to set up urea-water spray modeling in **CONVERGE**. In addition, we will review wall film and wall interaction models, phenomena (filming, rebounding, stripping, and separating) that can lead to urea deposit formation, and the application of conjugate heat transfer modeling to obtain accurate wall thermal boundary conditions. We will discuss SCR surface chemistry approaches that use **CONVERGE** coupled with **GT-SUITE**.

This workshop will include sample cases for practical Urea/SCR systems as well as validation cases. Finally, we will discuss future plans for improved engine aftertreatment modeling.

### **ADVANCED SPRAY MODELING** *08:00-10:00*

**CONVERGE** includes state-of-the-art models for simulating liquid spray phenomena. In this workshop, we will describe the models in **CONVERGE** for

liquid breakup, collision and coalescence, vaporization, drag, turbulent dispersion, and drop/wall interaction. In particular, we will discuss numerical mesh and parcel number settings for achieving grid convergence for RANS and LES simulations.

This workshop will also describe **CONVERGE**'s VOF-spray one-way coupling option, in which **CONVERGE** collects detailed fluid flow information near the nozzle exit during a VOF simulation of the injector flow and then uses this information to inject parcels for

**GAMMA TECHNOLOGIES** is the developer of **GT-SUITE**, a Model-Based Systems Engineering (MBSE) CAE system simulation tool. It provides a broad set of validated 0D/1D/3D multi-physics component libraries simulating the physics of fluid flow, thermal, mechanical, multi-body, structural, electrical, magnetic, chemistry, and controls. Utilizing these libraries, models can be built of practically any engineering system. **GT-SUITE** and **CONVERGE** offer streamlined integration to allow users of either program to leverage the power of both programs.



**GT-SUITE** users have access to **CONVERGE** Lite, which is a reduced version of **CONVERGE** that includes **CONVERGE**'s powerful and accurate 3D flow solver that can simulate complex geometries with no user meshing. **CONVERGE** Lite has an easy-to-use interface to rapidly set up simulations and perform parametric studies by creating multiple cases at a time.

**CONVERGE** users who also have a **GT-SUITE** license can take advantage of **CONVERGE**'s detailed chemistry solver, multiphase flow modeling, and other powerful features while performing advanced **CONVERGE** + **GT-SUITE** coupled simulations. Coupling applications include engine cylinder coupling, exhaust aftertreatment coupling, and fluid-structure interaction coupling.

[gtisoft.com](http://gtisoft.com)

Lagrangian spray calculations. Finally, in this workshop we will discuss the future of spray modeling in **CONVERGE**.

## **ADVANCED TURBULENCE MODELING**

*10:00-12:00*

**CONVERGE** includes a full spectrum of methodologies, from RANS to LES, to model turbulence. In this workshop, we will discuss the theory behind different methodologies and different turbulence models, as well as recommendations for and limitations of each model. In addition, we will discuss the results of some published RANS and LES simulations.

## **ADVANCED COMBUSTION MODELING**

*13:00-17:00*

**CONVERGE** contains several options for three-dimensional combustion modeling in internal combustion engines. In this workshop, we will discuss five advanced combustion models: delta

PDF (SAGE), G-Equation, Representative Interactive Flamelet (RIF), 3-Zone Extended Coherent Flame Model (ECFM3Z), and Flamelet Generated Manifold (FGM). SAGE and FGM are generalized combustion models that can be applied to diffusion-controlled diesel engine simulations or premixed gasoline engine simulations. G-Equation is suitable for simulating premixed spark ignition processes in gasoline engines, while RIF and ECFM3Z are used for simulating diffusion-controlled diesel engines.

This workshop will focus on the underlying theory and the advantages and disadvantages of each combustion model, as well as how these models are coupled with the CFD solver in **CONVERGE**.

## **ADVANCED TOPICS IN INTERNAL COMBUSTION ENGINE MODELING**

*13:00-17:00*

In this workshop, we will discuss several of the unique features of **CONVERGE** that yield efficient and accurate simulations of internal combustion (IC) engines. With optimized cell counts via Adaptive

Mesh Refinement and fast flow and detailed chemistry solvers, you can extend your simulation domain to include multiple cylinders to analyze cylinder-to-cylinder variation, run multiple cycles to understand cycle-to-cycle variation, and capture propagating pressure waves to resolve engine knock. We will discuss published cases and how to set up similar cases in **CONVERGE**.

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## **FRIDAY 10 MARCH**

### **ADVANCED CONJUGATE HEAT TRANSFER MODELING**

*08:00-12:00*

For several years **CONVERGE** has been able to interface with other software packages to model heat transfer in solids. Now **CONVERGE** can do both CFD and solid heat transfer modeling in the same simulation, which can simplify the process of predicting the temperatures in solids that are dependent on fluid interfaces, e.g., heads and valves in engines. This workshop will discuss conjugate heat transfer modeling in

CONVERGE, including supercycling, which accounts for the disparate timescales in the solid and fluid domains by allowing the solid side of the simulation to progress with faster timescales than the fluid side of the simulation, and valve/seat contact resistance in engines, which is critical to accurate prediction of valve and head temperatures.

### **ADVANCED FLUID-STRUCTURE INTERACTION MODELING**

*08:00-10:00*

Rigid body fluid-structure interaction (FSI) modeling describes how the presence of one or more immersed objects affect the flow field and how the forces from the surrounding fluid influence the dynamics of the object. In this workshop we will discuss the theory behind FSI, the numerics of the dynamics solver, and the coupling of the dynamics solver to the flow solver in CONVERGE. We will consider several examples (a pressure relief valve, a spool valve, and an injector armature) that highlight the current capabilities of FSI modeling in CONVERGE. Finally,

we will discuss complex examples that invoke a user-defined function coupled with FSI to model deforming bodies such as reed valve petals or a spring-close ball valve.

### **CONVERGE - GT SUITE COUPLING**

*10:00-11:00*

CONVERGE and GT-SUITE can be coupled in a variety of ways. This workshop will discuss two coupling options. In conventional 1D-3D coupling, CONVERGE performs a 3D simulation while GT-SUITE performs a 1D simulation. The information at the interfaces is exchanged or mapped between the two programs. In hydro mechanical coupling, you define a system with rigid bodies in GT-SUITE and subject the rigid bodies to fluid forces and constraints using CONVERGE. CONVERGE calculates the forces on the object and relays this information to GT-SUITE. GT-SUITE then solves the rigid body dynamics equations to update the object's state and sends this information back to CONVERGE. Finally, CONVERGE moves the object.

### **ENSIGHT WORKSHOP**

*11:00-11:30*

EnSight Desktop for CONVERGE is licensed by Convergent Science for all CONVERGE customers. In this introductory session you will learn how to obtain an EnSight license and who can provide support as you use EnSight.

Furthermore, you will learn about the capabilities of EnSight Desktop for CONVERGE; the differences between EnSight Desktop, Standard, HPC, and VR; and what's new in version 10.2.

### **RUNNING CONVERGE IN THE CLOUD WITH RESCALE**

*11:30-12:00*

Join Rescale for a demonstration of how you can use Rescale's cloud HPC platform to accelerate your CONVERGE simulations. Learn how to easily set up and execute CONVERGE simulations in the cloud with on-demand CONVERGE licensing and scalable, pay-as-you-go hardware. We will also discuss the benefits of simulation in a cloud-based environment like Rescale. Through



concrete engineering use-cases and benchmark results, we will illustrate how Rescale can be used to analyze CONVERGE models efficiently, interrogate those models, and share results without transferring large data sets.

## **GAS TURBINE ENGINE COMBUSTION**

*13:00-17:00*

This workshop will focus on the application of CONVERGE to gas turbine

combustion and combustor analysis. We will review how to set up liquid and gaseous fuels for gas turbines and discuss the use of both the SAGE detailed chemistry solver and the Flamelet Generated Manifold model for gas turbine models. In addition, we will discuss wall temperature predictions with conjugate heat transfer; transient RANS and LES simulations and steady-state analysis in reacting and non-reacting cases; gas turbine ignition at high altitude, lean blow out, and extinction; flashback; and emissions analysis for NOx, CO, and soot.

## **ADVANCED SEALING**

*13:00-15:00*

CONVERGE contains a sealing tool, which will close gaps between parts that are moving relative to one another. The sealing process is dynamic in that the surface enclosing the computational domain is recreated at each time-step based on the boundary motion and the seal definitions, and thus this tool can be applied to a variety of cases, including two-stroke engines, Wankel engines, components connected by

**SES-Tec**, *competent partner for your engineering demands.*

In the competition for the best products the solution of multi-physics problems plays an increasingly important role. **SES-Tec**, stands for Scientific & Engineering Simulation-Technology and supports customers in the field of multi-physics simulations and the creation of simulation methods.

The core competencies of **SES-Tec** comprise the creation and application of numerical methods of fluid dynamics, thermodynamics, structural mechanics and particle and process engineering. To get the maximum out of the available opportunities for the customer, **SES-Tec** see themselves not as pure development service provider, but more as a development partner.

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pins and bearings, pumps, and rotating machinery. We will give an overview of the sealing algorithm and explain the geometric approach used to recreate the sealed surface from the boundaries and seal definitions. We will discuss best practices for surface preparation and case setup, and we will demonstrate examples of applying seals to a check valve, a two-stroke engine, a Wankel engine, crankcase components, a gerotor pump, and a supercharger.

## GENETIC ALGORITHM OPTIMIZATION

15:00-17:00

This workshop will focus on model optimization in **CONVERGE**, including Genetic Algorithm (GA) optimization and Design of Experiments model interrogation. We will discuss different types of optimization and the details of the GA methodology, and we will use examples to illustrate how to set up the utility, select parameters, and run an optimization. Finally, we will discuss

the best practices of optimization (e.g., model setup, parameter and range selection, and search space considerations) and advanced applications such as geometry modification.



**CEI**—founded in 1994 with headquarters in Apex, North Carolina, USA—is the creator of **EnSight**, the leading software solution for visualizing, analyzing, and communicating data from complex mono- and multi-disciplinary numerical simulations.

With support for parallel data processing and distributed graphics rendering, **EnSight** provides high performance for even very large models and can post-process both CFD and Crash results. **EnSight** supports an extraordinary number of solver data formats, which makes it perfectly fitted for post-processing interdisciplinary CAE results such as FSI or MBS with nonlinear FE-bodies. A Python API empowers users to customize the software to meet their specific needs.

The German subsidiary of **CEI** was established in 2009 near Munich and is responsible for the German-speaking market as well as Northern and Eastern Europe. In addition to sales and support, **CEI GmbH** conducts projects to embed **EnSight** as the post-processing engine in automated and highly customized workflows.

[ensight.com](http://ensight.com)



# CFD is complex.

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Convergent Science offers **free** introductory and advanced training sessions throughout the year at our offices in Europe and the US.

## UPCOMING TRAINING DATES: LINZ, AUSTRIA

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03—07 April, 2017  
03—07 July, 2017  
02—06 October, 2017

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For upcoming dates in the US, please visit our website at [convergecf.com/events/us](http://convergecf.com/events/us)

Don't see a time that is convenient for you?  
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### For US training, contact:

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(608) 230-1500



# NETWORKING EVENTS



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## WELCOME RECEPTION

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**PARKHOTEL SCHÖNBRUNN | GLORIETTE BAR**  
TUESDAY 07 MARCH 19:00

Join us and network with your peers at the beautiful Gloriette Bar in the Parkhotel Schönbrunn as we kick off our inaugural European CONVERGE User Conference.

*Food and beverages will be served.*



## CASTLE SCHÖNBRUNN GRAND TOUR & DINNER

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**CASTLE SCHÖNBRUNN**  
WEDNESDAY 08 MARCH 18:30

We will take you on a journey through the centuries with cultural treasures of the Habsburg dynasty. The grand tour will be followed by a dinner in the more than 300-year-old Castle Schönbrunn.

*Meet in the lobby of Parkhotel Schönbrunn and we will walk together to the castle.*



## HEURIGEN NIGHT

**WERNER WELSER HEURIGER**

**THURSDAY 09 MARCH 19:00**

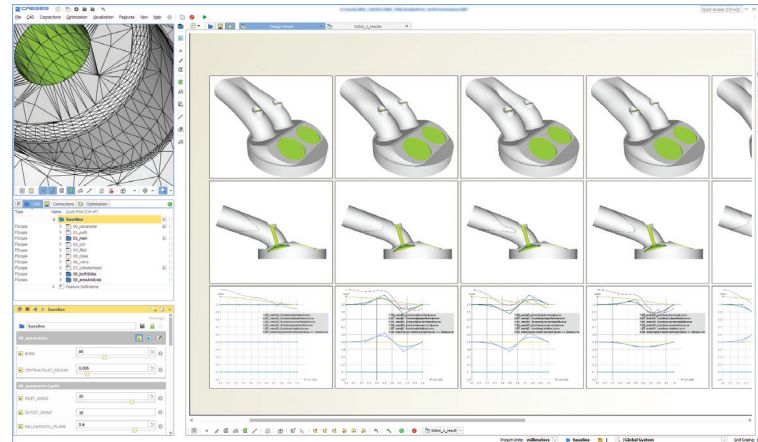
Do not miss the opportunity to experience a traditional Austrian night in a tavern known for its atmosphere of Gemütlichkeit (warmth and friendliness). Enjoy good wine, simple food, and traditional live music in a rustic tavern in a well-known winery region of Vienna.

*Meet in the lobby of Parkhotel Schönbrunn and a shuttle will transport you to the tavern.*



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# CONVERGE

## CFD SOFTWARE

Join us **25-29 September, 2017** for the **2017 CONVERGE USER CONFERENCE-NORTH AMERICA** in Detroit, MI, USA.  
For more information and to register, please visit [uc.convergecf.com](http://uc.convergecf.com)

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