ccrt
Centre de calcul recherche et technologie

cea

The CCRT, located in Bruyères-le-Châtel (France) under the responsibility of CEA DAM Île-de-France teams, is one of the few computing centres in Europe open to industry.

It offers a rich portfolio of high-performance computing (HPC) competencies, matching the growing needs of its partners, by combining secure and flexible access to its resources in a sustainable way.

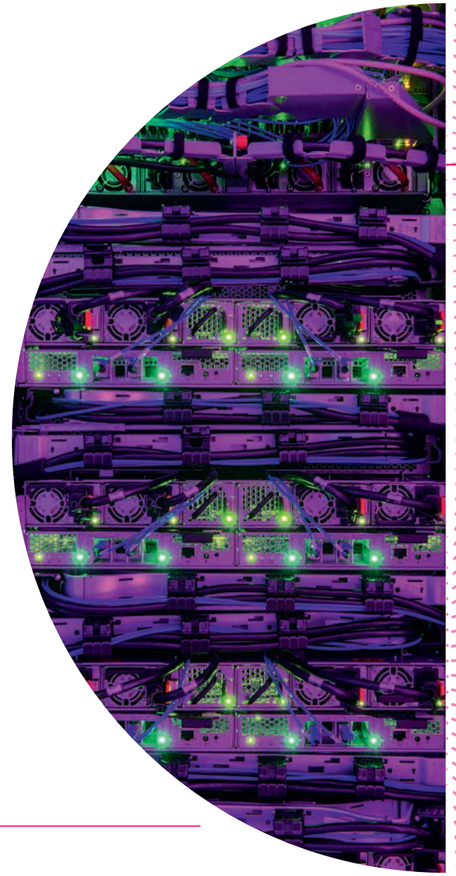
CCRT DNA

CEA expertise and competencies
Offer a best-breed high-performance computing and data analytics centre.

From research to industry
Support industrials in their use of numerical simulation and high-performance data analytics and prepare simulation tools for the future through partnership agreements.

Reliability and performance
Integrated services in a secure and reliable HPC environment.

Sharing of partners' experiences
Workshops, technology watch, an annual scientific conference.



TOPAZE

- **Atos BullSequana XH2000 system,** liquid-cooled (DLC: Direct Liquid Cooling)
- **864 nodes with 128 2.45 Ghz** AMD-Milan cores each, and 256 GB of memory/node
- **48 nodes with 4 Nvidia A100 processors** + 2 AMD-Milan processors, and 512 GB of memory/node
- **4 nodes with 2 AMD-Milan processors,** 1 Nvidia V100 processor, and 4 TB of memory/node
- **InfiniBand HDR** interconnect network
- **Private storage system:** 3 PB, Lustre, 280 GB/s bandwidth
- **CEA OCEAN** system software stack and administration environment
- **Batch and scheduler system:** Slurm®

COMPUTING RESOURCES

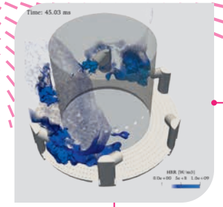
CCRT computing resources benefit from the exceptional infrastructures of **CEA's Very Large Computing Centre** (TGCC).

CCRT core element is **TOPAZE supercomputer**, a cluster built and installed by Atos-Bull in 2021. With an initial computing power of 8.8 petaflops, TOPAZE is sized to meet the growing needs of the partners thanks to its scalable architecture. CCRT benefits from the shared storage infrastructure of the TGCC, which can accommodate large volumes of data over the very long term. Since 2018, CCRT has deployed an Atos Quantum Learning Machine, with a 30 qubits emulation capacity. This gave CCRT's partners early opportunities to explore quantum computing programing and potential use cases.

Post-processing, remote visualization resources and virtualization features underlie and complement the range of services proposed to the users. **Access to CCRT** is ensured by secure links *via* the national telecommunications network for technology, teaching and research (Renater).

KNOW-HOW AND EXPERTISE

With the expertise developed as part of the CEA Simulation programme, the teams of the Department of Simulation and Information Sciences of the CEA DAM Île-de-France put their knowledge at the service of CCRT.
All the skills required for the design and implementation of very large computing infrastructures with a high-performance and secure production and data management environment can be found at CCRT: from energy optimization of the computing centre to the development of open source system software (Lustre, Slurm®, WI4MPI, Selfie, Robinhood…).



SAFRAN

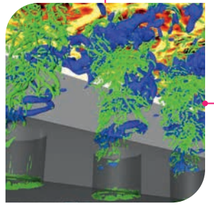
Ignition of a test bench of a helicopter engine combustion chamber

© Safran Group

SAFRAN

New “open rotor” turbomachines architecture

© Safran Group



SAFRAN

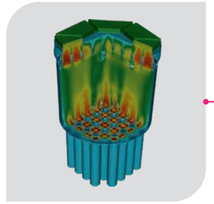
Zoom of a perforated pipe test case representing a simplified version of a typical LPTACC geometry

© Safran Group

ONERA
THE FRENCH AEROSPACE LAB

Atomization in rocket engines: direct numerical simulation of liquid-gaz assisted atomization in fiber regime

© ONERA



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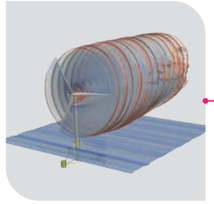
Turbulent flow in an upper plenum of a nuclear reactor for naval propulsion computed through RANS modelling

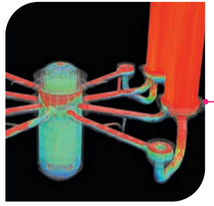
© CEA/DES



IFP Energies nouvelles

GPUs for wind energy: towards real-time wind-turbine simulations using vortex methods and a high fidelity LBM approach

© IFPEN



EDF

Neptune_cfd simulation of a loss of coolant accident on a PWR primary circuit

© EDF

IRSN
INSTITUT DE RADIOPROTECTION ET DE SÛRETÉ NUCLÉAIRE

Large Eddy Simulation of a deflagration experiment from the literature to access the turbulent flow characteristics - Flame brush

© IRSN

INERIS
maîtriser le risque pour un développement durable

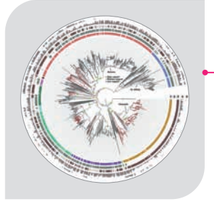
Nitrogen oxides concentrations on January 23rd, 2014

© Ineris

ThalesAlenia Space

Space Inspire: our new digital and reconfigurable in-orbit solution

© Thales Alenia Space



FRANCE GENOMIQUE

From thousands of marine plankton samples collected by the Tara Ocean expedition across the globe, 38 billion metagenomic DNA reads were assembled by Genoscope-CEA Evry researchers at CCRT, in one collection of about 700 eukaryotic genomes. The study of the gene repertoire of these genomes provides genetic keys to functional convergences, very far apart in evolution
http://dx.doi.org/10.1101/2020.10.15.341214

© France Génomique

Studies on the development of new aircraft and helicopter engines

New means of propulsion for the ASD (Aeronautics-Space-Defense) sector

Technologies for energy and ecological transition

Design and safety of nuclear reactors

Environmental hazards analysis

Design of new satellites to improve connectivity and reduce the digital divide

Bio-informatics analysis for high rate genomics

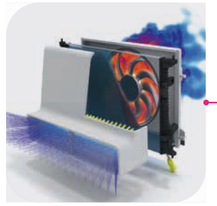
OVERVIEW OF CCRT USES

- Design and manufacturing of tires and integrated systems for automobiles
- Design of sustainable mobility solutions and technologies
- Design of new large research instruments
- Research for new materials and *ab initio* simulations
- Development of more environmentally friendly cosmetics
- Development of design methods for naval defence systems
- High fidelity multi-physics numerical simulation for complex systems analysis
- Design of future European space means of transport

MICHELIN

Aquaplaning simulation through fluid-structure interaction of a worn tire rolling on a water layer

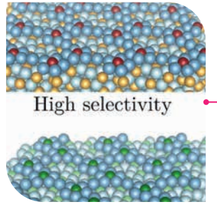
© Michelin



Valeo

Engine cooling module for electrical car

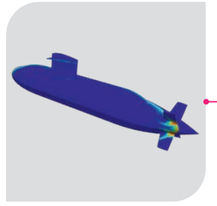
© Valeo



SOLEIL SYNCHROTRON

Catalytic activation of a non noble intermetallic surface through nanostructuration under hydrogenation conditions revealed by atomistic thermodynamics

© Synchrotron Soleil



NAVAL GROUP

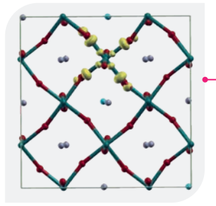
Simulation of a ship facing an underwater explosion

© Naval Group

L'ORÉAL Recherche & Innovation

Realistic physical modelling of hair.
L'Oréal-Inria collaboration

© L'Oréal



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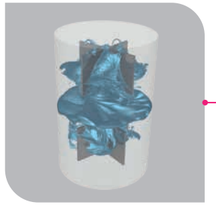
Isosurface of the density of probability associated with a hole polaron in a material for solid oxide fuel cell: $(La,Sr)FeO_3$. Blue, grey, green and red balls are respectively strontium, lanthanum, iron and oxygen atoms

© CEA/DAM



ingeliance

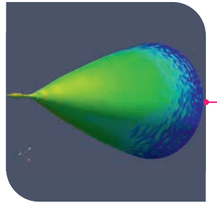
Transient CFD simulation of the mixing of two immiscible fluids in a tank

© Groupe INGELIANCE

arianeGROUP

Reentry of a reusable rocket stage

© ArianeGroup



THALES

Surface current on a fighter aircraft nosecone radome

© Thales

TA TechnicAtome

Suffren: french nuclear submarine

© CEA

A RELIABLE, SECURE ENVIRONMENT

CCRT runs operations round-the-clock except for scheduled maintenance periods. On-site support from the Atos supplier and expert administration teams with on-call duty optimize the availability of the computing service.
CCRT takes access and data management security very seriously. A CEA IT security unit is in charge of a supervision system that monitors, detects and analyses alerts, allowing the security managers to react extremely rapidly.

USER ASSISTANCE

- A single point of contact for the users: **hotline.tgcc@cea.fr - tel.: +33 1 77 57 42 42**
- A specific website for the users: **https://www-ccrt.ccc.cea.fr**
- Application support: a team of HPC specialists provides its expertise on the porting and optimization of user codes on the CCRT machines.

www-ccrt.cea.fr

CCRT ASSETS

TRAINING

- Regular training sessions cover parallel programming (MPI, OpenMP, as well as GPU programming, Quantum Computing, development environments and tools). Technology watch and presentation of new technologies, before their integration into the production machines, helps the adaptation of applications.
- CCRT offers “getting started” sessions for the newcomers.

DYNAMIC EXCHANGES BETWEEN PARTNERS

In order to share the expertise of its teams with its partners, and more generally take advantage of the strategies and skills of each one, CCRT regularly organises technological or thematic workshops.
CCRT also organizes an annual scientific workshop, open to all, which is an opportunity for the users to stay tuned with the latest technologies and services deployed. Those workshops are also the opportunity for CCRT users to present their scientific results.

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