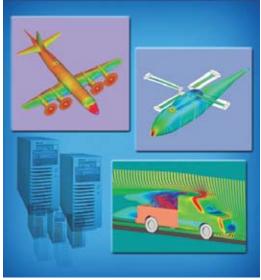## *Computational Facilities*

To provide the resources and the tools to perform state-of-the-art modeling and simulation is the goal of the Aerodynamics Laboratory Computational Facilities (CF) at the NRC Institute for Aerospace Research (NRC Aerospace). With the CF's advanced High Performance Computing (HPC) systems and full suite of complementary software, NRC Aerospace computational fluid dynamics (CFD) practitioners are able to support a wide range of clientele. Its CFD researchers also develop new and innovative methods to conduct leading-edge research in a broad spectrum of computational aerodynamics challenges ranging from turbulence modeling to full vehicle flow simulations.

**Hardware resources**

The CF maintains a collection of computing systems that can be broadly grouped in four categories: computing power, visualization systems, desktop workstations, and infrastructure.

The HPC resources of the CF consists of several Linux PC clusters with its core system being a continually expanding dual Opteron® cluster with over 80 computing nodes, 232 GB of distributed memory and 12 TB of data storage. Internode communications are handled through a combination of Myrinet® and gigabit Ethernet. The CF also supports a dual 16-node Intel Pentium 4® cluster, which is a combination of 2.2 and 2.8 GHz processors and an 18-node DEC Alpha® 21164 cluster. The Intel cluster is wired with Myrinet and gigabit Ethernet, while the DEC Alpha cluster uses Fast Ethernet as its interconnect. A 32 R12000 CPU SGI Origin 2000 with 16 GB of memory is also available.



*CFD simulations performed on CF HPC systems*

The CF's visualization hardware includes several high-end Linux and SGI workstations. In addition, it has access to virtual reality facilities maintained within the NRC.

**Software resources**

The CF maintains a range of software tools that empowers its researchers to provide exceptional client support and leading-edge research in CFD modeling and simulation. To complement the state-of-the-art CFD programs developed by NRC Aerospace staff, the CF makes available a collection of commercial, freeware and open-source tools including simulation software, compilers, visualization packages, grid-generation programs and communication libraries.

| High Performance Computing (HPC) Systems | | | | |
|---|---|---|---|---|
| | **Ewoks** | **Challenger** | **Voodoo** | **Arrow** |
| **Description** | PC Cluster | PC Cluster | PC Cluster | SGI ORIGIN 2000 |
| **OS** | Linux | Linux | Linux | IRIX |
| **Number of Nodes** | 18 | 16 | 80 | N/A |
| **CPUs/Node** | 1 | 2 | 2 | N/A |
| **CPU Model** | Alpha 21164 | Pentium 4 | Opteron 248 | R12000 |
| **CPU Speed** | 600 MHz | 2.2 & 2.8 GHz | 2.4 GHz | 300 MHz |
| **CPU L2 Cache** | 2 MB | 512 KB | 1MB | 8 MB |
| **RAM/Node** | 256 MB | 2 GB | 4/8/16 GB | 16 GB Shared |
| **Interconnect** | Fast Ethernet | Myrinet & Fast Ethernet | Myrinet & Fast Ethernet | N/A |
| **Schedulers** | N/A | PBS | Grid Engine | PBS |
| **Storage** | 72 GB | 144 GB | 9 TB | 1 TB |

(The "Specifications" label spans the rows from OS to Storage.)

**Additional hardware resources:**
- Linux and SGI workstations
- Backup and archival systems
- Ethernet backbone
- Colour printers

| Software Resources | | | | |
|---|---|---|---|---|
| **CAD & Grid Generation** | **Simulation** | **Visualization** | **Communication** | **Compilers** |
| MCADS<br>PRO/E®<br>IDEAS®<br>ICEM-CFD®<br>CFD-GEOM® | USAERO®<br>PMARC<br>WIND<br>NPARC<br>SPARC<br>FLOWer<br>CFD-FASTRAN®<br>PowerFLOW® | VU<br>TECPLOT®<br>FIELDVIEW®<br>CFD-VIEW®<br>PowerVIZ® | PVM<br>MPICH<br>LAM-MPI | Portland Group<br>Compaq<br>SGI<br>GNU |

**CONTACT:**

Dr. Ali Benmeddour
Aerodynamics Laboratory
NRC Institute for Aerospace Research
Ottawa, Ontario, Canada K1A 0R6
Tel: (613) 991-3280      Fax: (613) 992-1281
E mail: ali.benmeddour@nrc.gc.ca

Dr. Jerry Syms
Aerodynamics Laboratory
NRC Institute for Aerospace Research
Ottawa, Ontario, Canada K1A 0R6
Tel: (613) 998-1266      Fax: (613) 957-4309
E mail: jerry.syms@nrc.gc.ca

Mr. Jeff Mackwood
Marketing and Contracts Office
NRC Institute for Aerospace Research
Ottawa, Ontario, Canada K1A 0R6
Tel: (613) 990-0765      Fax: (613) 952-7214
E mail: jeff.mackwood@nrc.gc.ca

Or visit our Web site at: www.nrcaerospace.com