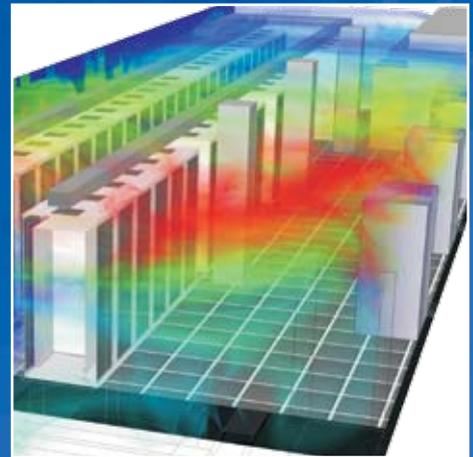


FloVENT®

Optimizing Data Center Cooling by Simulation



**Mentor
Graphics®**

Mechanical Analysis

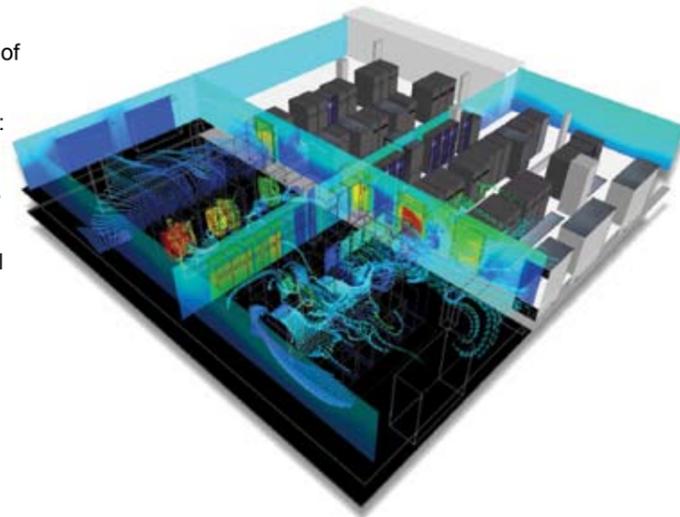
Optimizing Data Center Cooling Through Simulation

Why Perform Airflow/Thermal Simulation in Data Centers?

Providing adequate cooling is a major challenge for modern data center designers and operators, due to the escalating power densities associated with blade servers and other high-speed computing and switching equipment. Individual server rack heat loads now commonly exceed 10kW, and may reach over 30kW. According to a recent study^[1], power consumption in US data centers doubled between 2000 and 2005, reaching in 2005 a figure approximately equal to the power consumed by all color televisions in the USA. Power consumption in data centers is expected to grow by a further 40% by 2010. Energy costs for power and cooling in data centers are now greater than the cost of the IT equipment itself, when amortized over a three-year period^[2].

The FloVENT simulation software from Mentor Graphics creates a "virtual" data center with detailed 3D visualization of airflow and temperature at every point throughout the room. Armed with this vital information, you can quickly and easily:

- Minimize cooling power requirements and energy costs
- Optimize data center cooling effectiveness
- Ensure that temperatures are within specifications at all rack inlets and throughout the room
- Eliminate hot spots thus avoiding potential equipment failures and downtime
- Simulate transient effects (e.g. temperature build-up following CRAC failure)



Why Choose FloVENT for Airflow Simulation in Data Centers?

Since 1988, Mentor Graphics' Mechanical Analysis Division has played a pioneering role in simulation of airflow and thermal comfort in all kinds of buildings using Computational Fluid Dynamics (CFD) techniques. As a result, FloVENT has become the most widely used, most validated, most dependable, and fastest CFD software for this type of application.

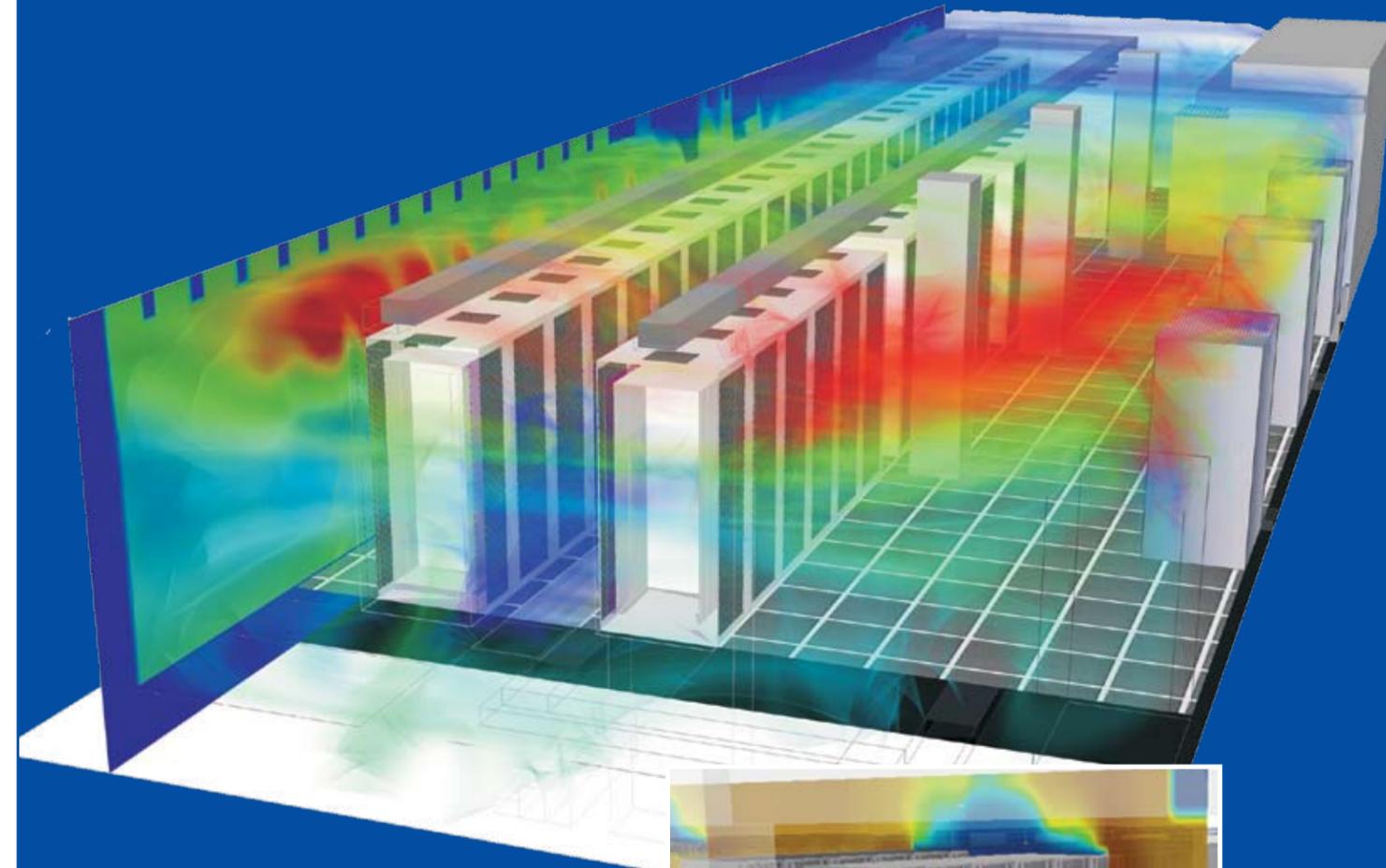
You may choose to employ Mentor Graphics as a consultant, and/or license the FloVENT software for in-house use. Either way, we will help you minimize operating costs and downtime by visualizing and optimizing airflow, temperature distribution and cooling system performance.

“ FloVENT is designed specifically for modeling heating and cooling applications so it is both easier to use and more powerful than other CFD codes when evaluating data center cooling. Mentor Graphics, Mechanical Analysis also has a team of support engineers that provide excellent support because they have a very good understanding of data center cooling issues. ”

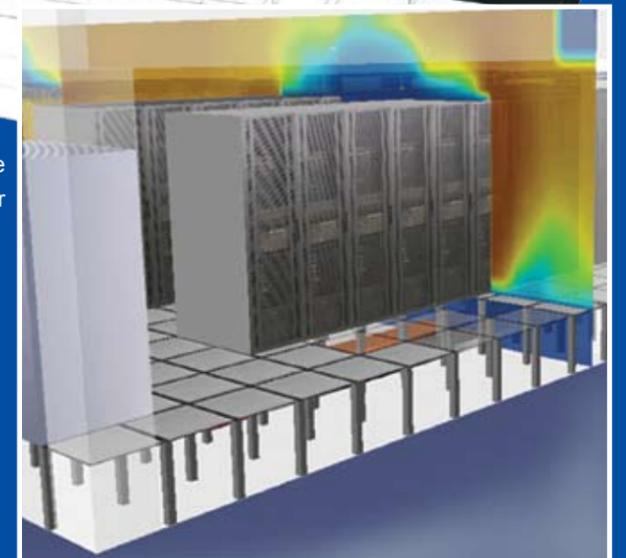
[1] "Estimating total power consumption by servers in the US and the world", Jonathan G. Koomey, Ph.D, Staff Scientist, Lawrence Berkeley National Laboratory and Consulting Professor, Stanford University, Final report, February 15, 2007

[2] "In the data center, power and cooling costs more than the IT equipment it supports", Christian L. Belady, P.E., Hewlett-Packard, Electronics Cooling Magazine, Volume 13, Number 1, February 2007

*Ben Steinberg, Senior Engineer,
American Power Conversion (APC)*



Ventilation and temperature distribution within a Data Center

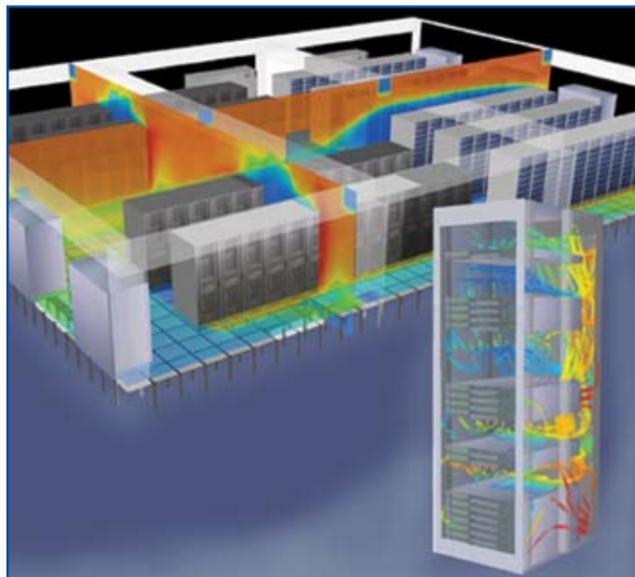


Optimizing Data Center Cooling Through Simulation

Validation

Since 1988, FloVENT has been applied and validated in a wide variety of data center cooling applications by companies such as APC, BSRIA, BT, Emerson, HP, and IBM. In addition, FloVENT is widely used and extensively validated by building designers, engineering design consultants, and building owner/operators for many different applications involving buildings of all types and sizes. This widespread use drives out software bugs and ensures robust simulation software that you can rely on. With Mentor Graphics and FloVENT, you can be sure that Simulation = Reality!

The following technical papers are just a small selection from the huge range of papers demonstrating that the world's leading companies rely on FloVENT for data center cooling simulations.



Validation Papers

The following is a partial list of technical papers that have validated the use of FloVENT for data center cooling or similar applications. Visit our website for a full list.

Cooling Solutions for IT, BSRIA Guidance Document

Nigel Pavey, Foreman Roberts
William Booth, BSRIA
Stuart Hall, Flomerics Ltd

Experimental-Numerical Comparison for a High-Density Data Center: Hot Spot Heat Fluxes in Excess of 500 W/ft²

Saurabh K. Shrivastava, American Power Conversion Corporation
Madhusudan Iyengar, IBM Systems & Technology Group
Bahgat G. Sammakia, Dept. of Mechanical Engineering
Roger Schmidt, IBM Systems & Technology Group 2455
James W. VanGilder, American Power Conversion Corporation

Airflow Uniformity Through Perforated Tiles in a Raised-Floor Data Center

James W. VanGilder, American Power Conversion Corporation
Roger R. Schmidt, IBM Corporation

Dimensionless Parameters for Energy-Efficient Data Center Design

Ratnesh K. Sharma and Cullen E. Bash, Hewlett-Packard Laboratories

A Non-Trial-and-Error CFD-Based Method For Balancing Airflow Through Floor Tiles in Raised-Floor Data Centers

Jim VanGilder, Flomerics

Raised Floor Computer Data Center: Effect on Rack Inlet Temperatures of Chilled Air Exiting both the Hot and Cold Aisles

Roger Schmidt, Ethan Cruz, IBM Corporation

Thermal Trends and Inflections Influencing the IT Roadmap

David S. De Lorenzo, Intel Labs

Thermal Considerations in Cooling Large Scale High Compute Density Data Centers

Chandrakant D. Patel, Ratnesh Sharma, Cullen E. Bash and Abdmonem Beitelmal, Hewlett-Packard Laboratories

The Performance of Displacement Cooling Systems in Telecom Applications

Ari Kemppainen, Ericsson R&D, Sweden

CFD Modeling of High Compute Density Data Centers to Assure System Inlet Air Specifications

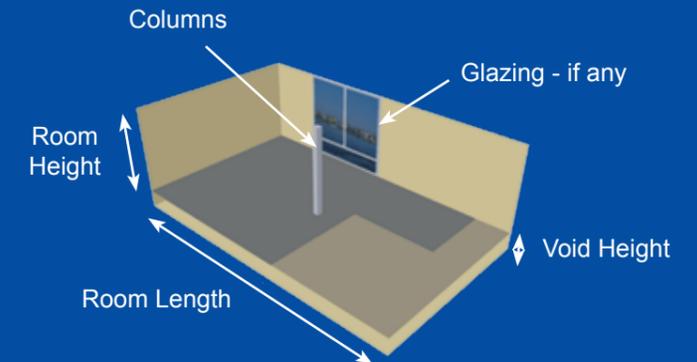
Chandrakant D. Patel, Cullen E. Bash and Christian Belady, Hewlett-Packard Laboratories

Lennart Stahl and Danny Sullivan, Emerson Energy Systems

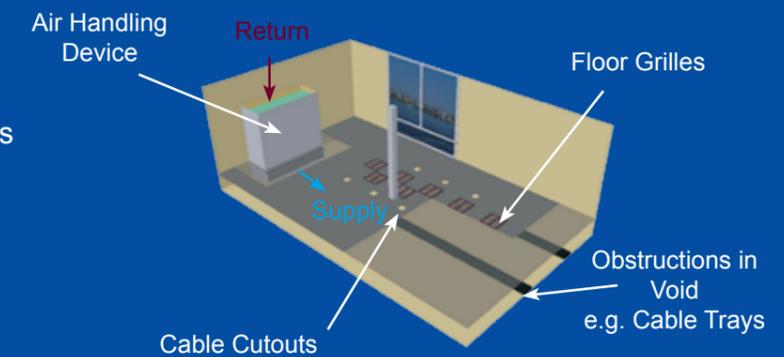
A Fresh Approach to Cooling Network Equipment

Peter Kiff, BT Networks and Systems

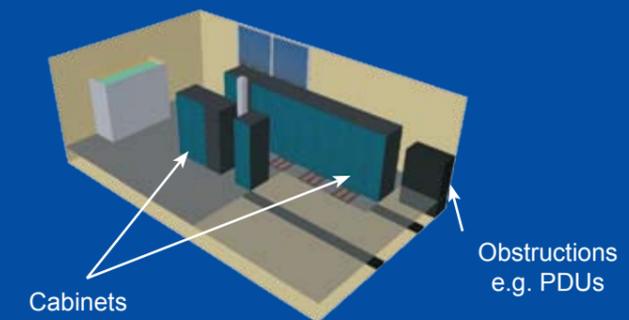
- 1. Room and Structure**
From design drawings, CAD or site survey



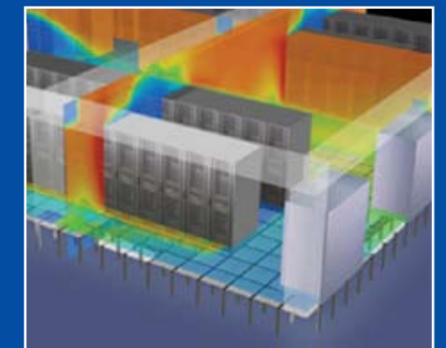
- 2. Ventilation**
Air handling device specifications from libraries based on manufacturers' data



- 3. Equipment**
Details and specifications of equipment housed in cabinets from data center configuration management system and manufacturers' data



- 4. Simulation Results**
Information about:
- Temperatures
- Pressures
- Air flow paths and velocities



Optimizing Data Center Cooling Through Simulation

FloVENT in Data Center Design and Operation

Data center cooling simulation using FloVENT contributes to both:

New-build designs

to evaluate design cooling performance, identify and remedy cooling problems or likely hot spots ahead of build; optimize layout and cooling to minimize power consumption; investigate possible cooling system failures and system redundancy;

and

Ongoing operation and change management

to assess and monitor intended and ongoing operational changes in equipment layout, cooling system, space utilization, etc, whilst minimizing cooling energy costs.

Of these the second is assuming increasing importance, as data center layout changes and equipment upgrades occur more and more frequently.

Clearly the operation of present-day data centers involves a multiplicity of issues in addition to cooling – asset lifecycle management, power infrastructure, network mapping, capacity planning, change management, and many more. FloVENT can be used alongside whatever data center management system is being used to address these, so as to provide a complementary “thermal audit” of cooling performance. This enables the operator to assess the potentially critical impact on cooling of the continual operational changes inevitable in present-day data centers.

You may choose to employ Mentor Graphics as a consultant, and/or license the FloVENT software for in-house use. Either way, we will help you minimize operating costs and downtime by visualizing and optimizing airflow, temperature distribution and cooling system performance for all your data center projects.

“ The benefits of undertaking CFD analysis are truly realized by Mentor Graphics’ Mechanical Analysis Division, their visual representations of temperatures and airflows have been the key on several of our projects. ”

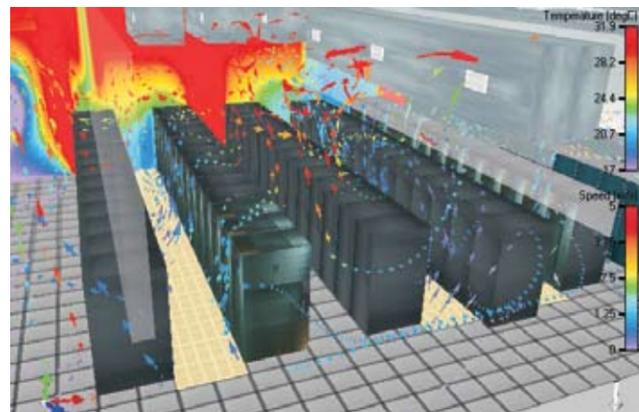
Derek Morgan, Technical Director, WSP Group Plc

Contact us today!

Visit
www.mentor.com/mechanical

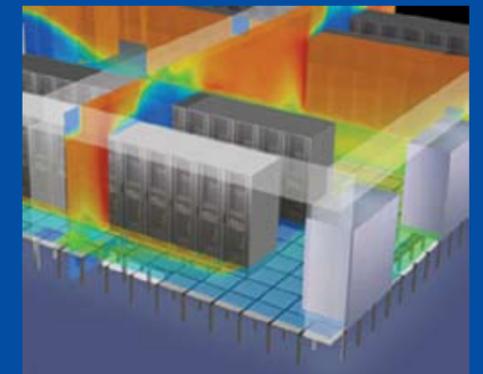
Email
info-mechanical@mentor.com

or call us direct at any of
our worldwide offices
listed on the back of this brochure.



We provide a computational test bed to evaluate airflow and thermal behaviour of current and future data center designs, and operational changes. Armed with this vital information, you can quickly and easily:

- Minimize cooling power requirements and energy costs
- Optimize data center cooling effectiveness
- Ensure that temperatures are within specifications at all rack inlets and throughout the room
- Eliminate hot spots thus avoiding potential equipment failures and downtime



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