

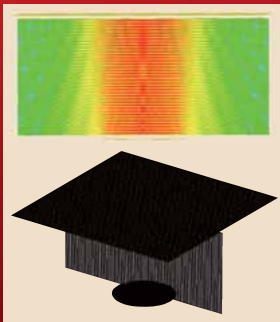
# Large-Scale Acoustic Analysis Software



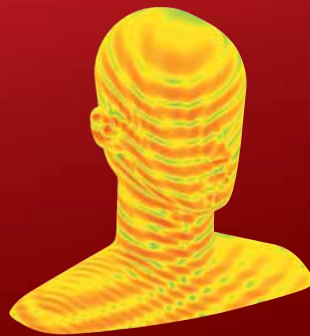
Powerful Acoustic Computing Environment

**Fast multi-pole boundary element method (FMBEM) solver enables acoustic analysis of very large-scale and high-frequency sound fields.**

### Examples of application to high-frequency region problems

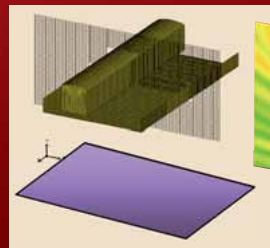


Sonar  
(154,884 DOF/1MHz)

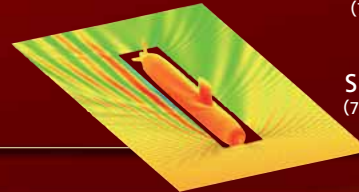


HRTF calculations  
(240,000 DOF/20KHz)

### Examples of application to spatially large-scale problems



Railway car  
(74,242 DOF/200Hz)

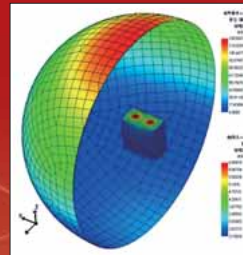


Ship  
(73,600 DOF/600Hz)

**NEW**

Fall 2008  
release

**Coupled analysis**  
(structural-acoustic,  
acoustic-acoustic,  
acoustic-structural-acoustic)



A simulation of sound transmitted from a sound source inside a box by coupling the top plate of the structural model to the acoustic model

### Ideal for the following needs

**High-precision acoustic analysis using a wave theory approach**  
**Acoustic analysis in a large-scale model or high-frequency region**  
**Cost and time reduction**

**WAON  
can do this!**

### Typical applications

**Automotive**

- Engine radiated sound
- Interior noise reduction

**Industrial equipment**

- Electric motor and compressor radiated sound

**Audio/home appliances**

- Speaker acoustic characteristics
- Head-related transfer function (HRTF) calculation

**Transportation**

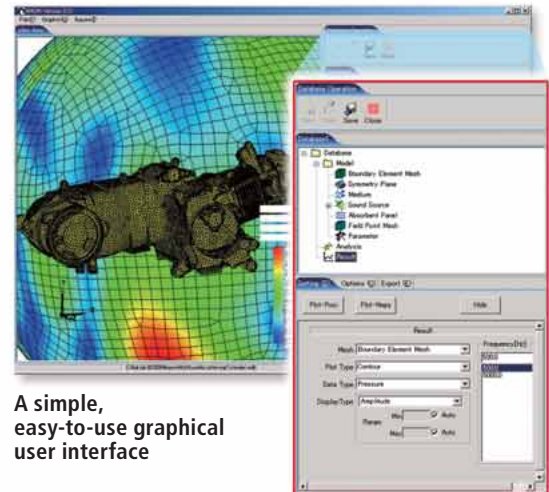
- Noise reduction in trains, ships, aircraft

## What Is WAON?

The boundary element method (BEM) conventionally used for acoustic analysis performs its simulations by generating a full matrix. The main limitations of this approach are the extreme demands on computing resources and the limited degrees of freedom (DOF) supported.

To overcome these limitations, Cybernet Systems developed the acoustic analysis software WAON adopting a fast multi-pole boundary element method (FMBEM) solver. This original software was released commercially in January 2006 as the first of its kind in the world.

By applying the fast multi-pole algorithm (FMA) to BEM, the memory required by the solver as well as the computational time are reduced to a small fraction of those required by conventional BEM, resulting in a leading-edge acoustic analysis program with astonishing performance.



A simple, easy-to-use graphical user interface

## WAON Features

### Feature 1 Applicable to large-scale and high-frequency region problems

WAON can be used to solve large-scale and high-frequency region problems that were not possible with conventional BEM solvers. On a 32-bit Windows machine (memory: 2GB), a model with 60,000 degrees of freedom (DOF) can be solved; and on a 64-bit Windows machine (memory: 8GB), the solvable DOF is 250,000.

### Feature 2 Outstanding performance

WAON is equipped with both a highly advanced FMBEM solver and fast BEM solver. Major speed enhancements have been made also in the BEM solver, making WAON applicable to a wide range of problems from small to large-scale models.

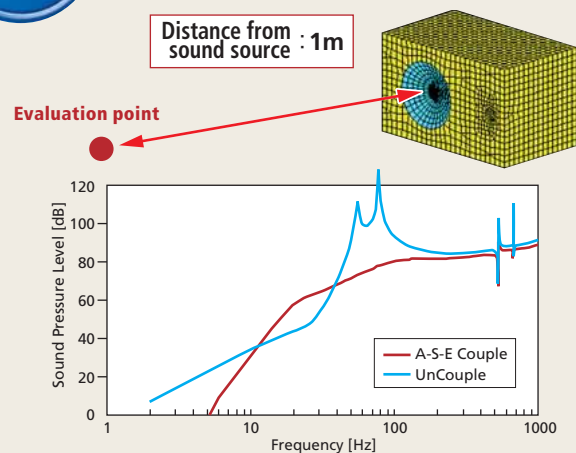
### Feature 3 User-friendly GUI minimizes the need for a manual

The graphical user interface is simple and easy to use, with plainly worded error messages. Even without prior experience, use of the software can be learned in a short time.

**NEW**

Fall 2008 release

## Example of coupled analysis application (structural-acoustic, acoustic-acoustic, acoustic-structural-acoustic)



Analytical results (frequency response curve)

## Main Functions

<b>Solvers</b>	Fast multi-pole boundary element method (FMBEM) solver and fast conventional BEM solver
<b>Analysis functions</b>	Internal problems, external problems, problems with aperture
<b>Element sets</b>	An element set is created automatically based on information defined in the mesh file (material characteristics, element characteristics, element type, other groups) An element set can be created and boundary conditions defined for that set.
<b>Acoustic media</b>	Complex velocity of sound can be defined.
<b>Symmetry planes</b>	Rigid walls with infinite surface area can be modeled.
<b>Sound sources</b>	Omni-directional point sound source or wall surface vibration velocity Definitions like the following are possible. <ul style="list-style-type: none"> <li>• Frequency-dependent values</li> <li>• Different vibration velocities for front and rear of element</li> <li>• Load vibration analysis results from structural analysis software and automatically define velocity boundary conditions in acoustic analysis mesh</li> </ul>

<b>Sound absorption</b>	Input as impedance, impedance ratio, admittance, or admittance ratio is supported. Definitions like the following are possible. <ul style="list-style-type: none"> <li>• Frequency-dependent values</li> <li>• Different sound absorption values for front and rear of element</li> </ul>
<b>Results processing</b>	3D color contour map, vector diagram, external output (sound pressure, particle velocity, sound power, intensity, displacement)
<b>Analysis parameter setting</b>	<ul style="list-style-type: none"> <li>• Maximum iterations, convergence tolerance, maximum memory use</li> <li>• Integration points used for element inner surface integrals</li> </ul>
<b>CAE interface</b>	Mesh data and structural analysis results (vibration analysis) from various CAE software can be used for vibration data.

For more details

<http://www.cybernet.co.jp/waon/english/>  
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