

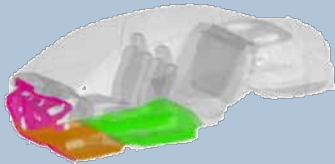
# ACTRAN Aero-Acoustics



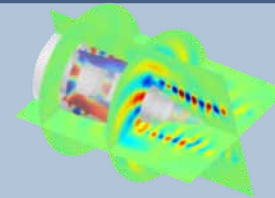
## Product overview

# ACTRAN Modules

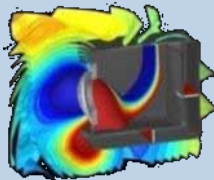
ACTRAN for NASTRAN



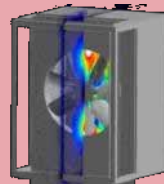
ACTRAN DGM



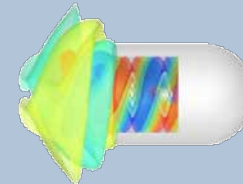
ACTRAN Vibro-Acoustics



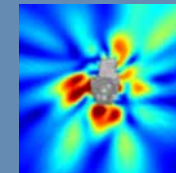
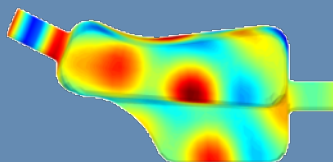
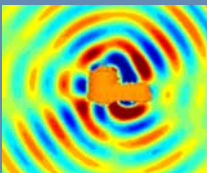
ACTRAN Aero-Acoustics



ACTRAN TM

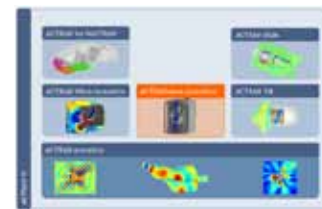


ACTRAN Acoustics



ACTRAN VI

# ACTRAN AeroAcoustics



## Û 流体騒音のための以下の機能を含む

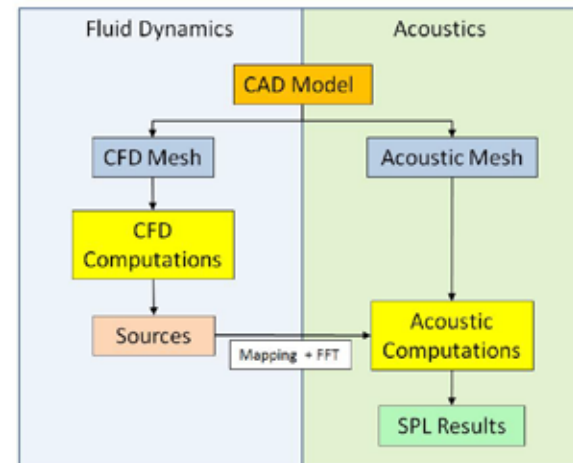
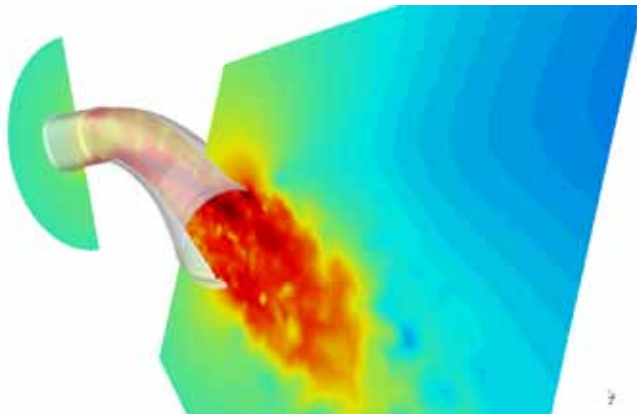
- § CFD とのインターフェース
- § Lightill 音源の取り扱い

## Û 前提

ACTRAN Acousticsが必須

## Û 応用:

- § ファン騒音
- § HVAC 騒音

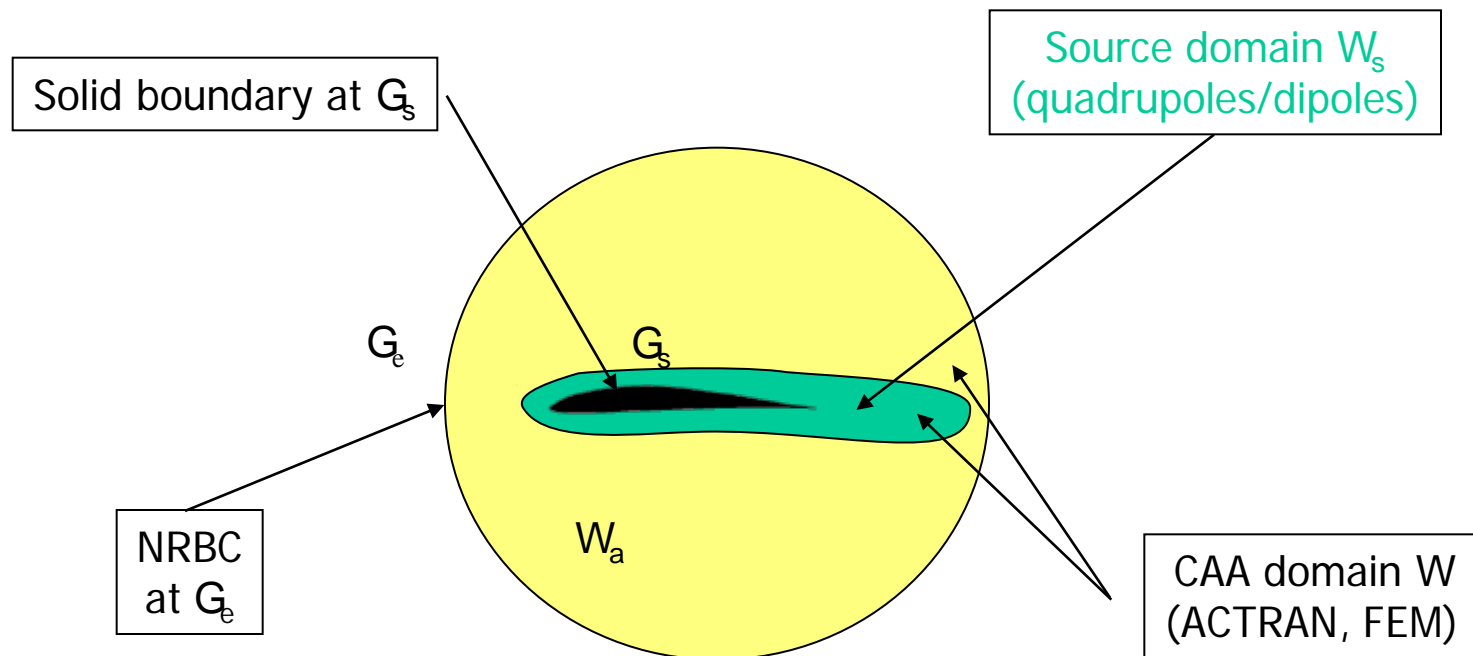


# 導入...



# Lighthill's Analogy:

- Ü A CFD 解析 (URANS, LES, DNS, ...) が流れ場を決定
- Ü 流体音源はこれらの値から計算
  - § Lighthill's analogyを適用



# Lighthill's Analogy:

- Ü Start from the equations of the Fluid Dynamics
- Ü Make as few assumptions as possible
- Ü Manipulate the equations to “form” a wave equation of this form

$$\frac{\partial^2 \rho_a}{\partial t^2} - a_0^2 \frac{\partial^2 \rho_a}{\partial x_i \partial x_i} = \{\text{Source Terms}\}$$

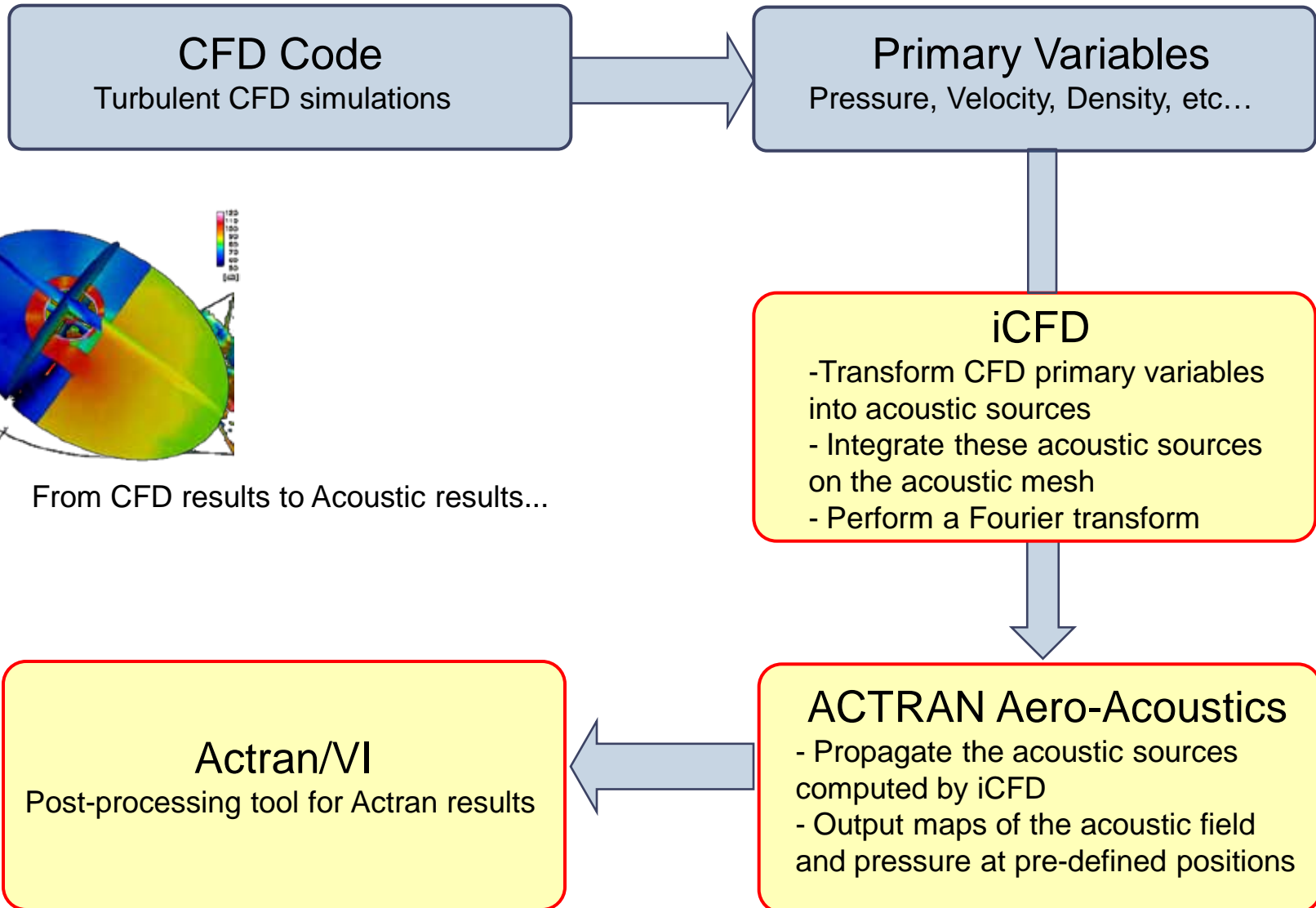
Where  $r_a$  is the acoustic variable

and the source term depends on  $r, u, v, w, p$

## Ü FEMの境界条件設定

- § 全ての境界条件設定が可能 !!!
- § この点が古典的な解放との最大の相違点  
(Curle, FWH or BEM)

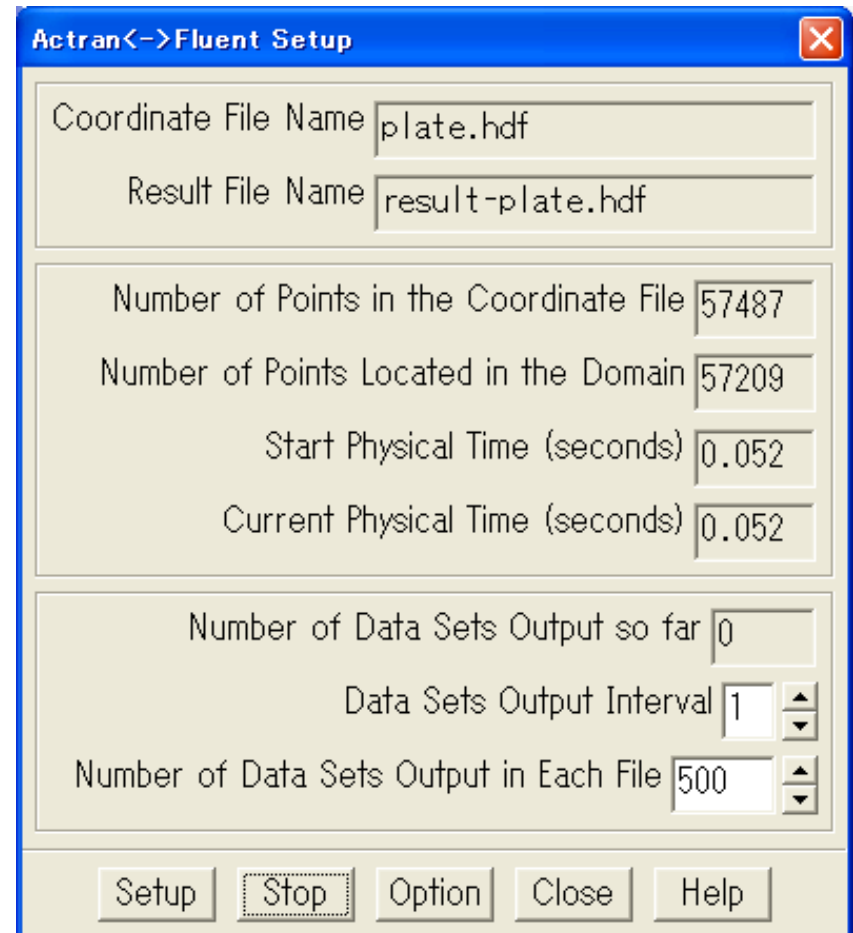
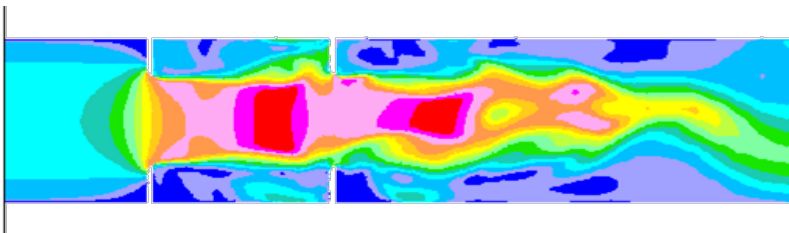
# Actran/Acoustic 解析手順



# CFD とのインターフェース

Ü The coupling is operational for most standard CFD codes

- § Star-CD
- § Star-CCM+
- § Fluent
- § CFX
- § Powerflow
- § AcuSolve
- § OpenFOAM
- § ...



Example: Fluent's GUI



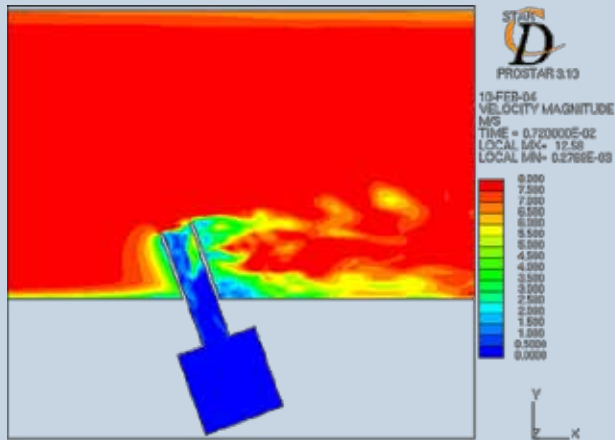
# 応用: 一般的な流れ



# ヘルムホルツ共鳴器

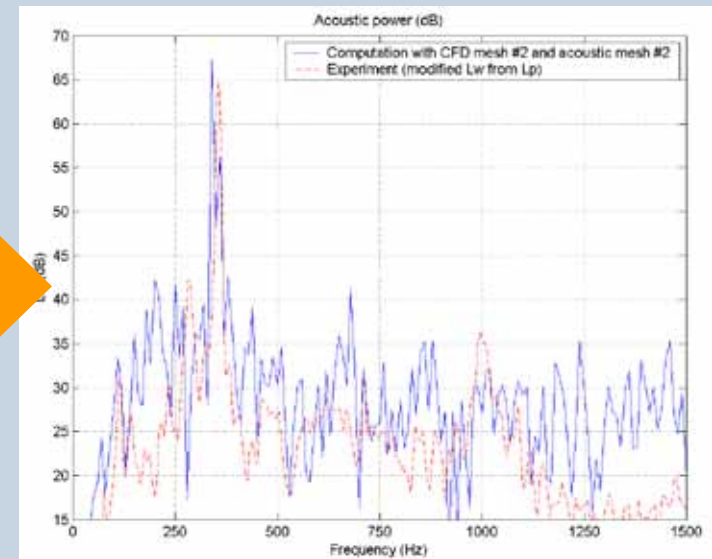
AIAA05-3067: Aeroacoustic Simulation of the Noise radiated by an Helmholtz Resonator placed in a Duct - *S.Caro, P.Ploumhans, X.Gallez, F.Brotz, M.Schrumpf, A.Read, F.Mendonca*

## CFD Results



BEHR

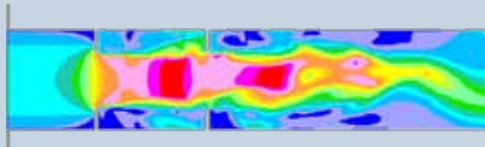
## Results



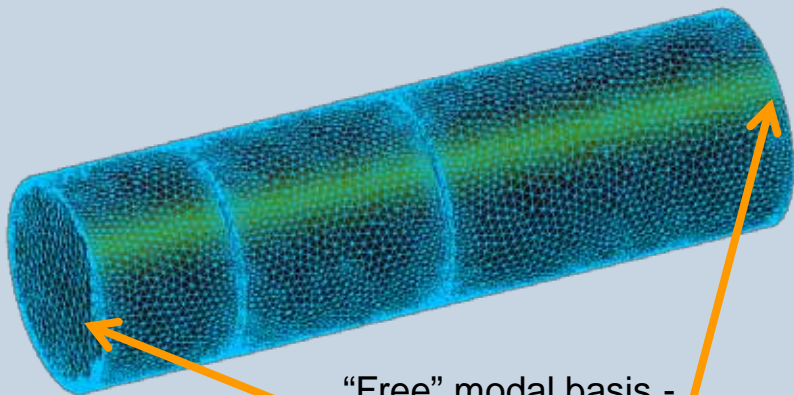
# 二重のダイアフラム

AIAA05-2976: Aeroacoustic Simulation of Double Diaphragm Orifices in an Aircraft Climate Control System - *F.Mendonça, A.Read, S.Caro, K.Debatin, B.Caruelle*

## CFD Results

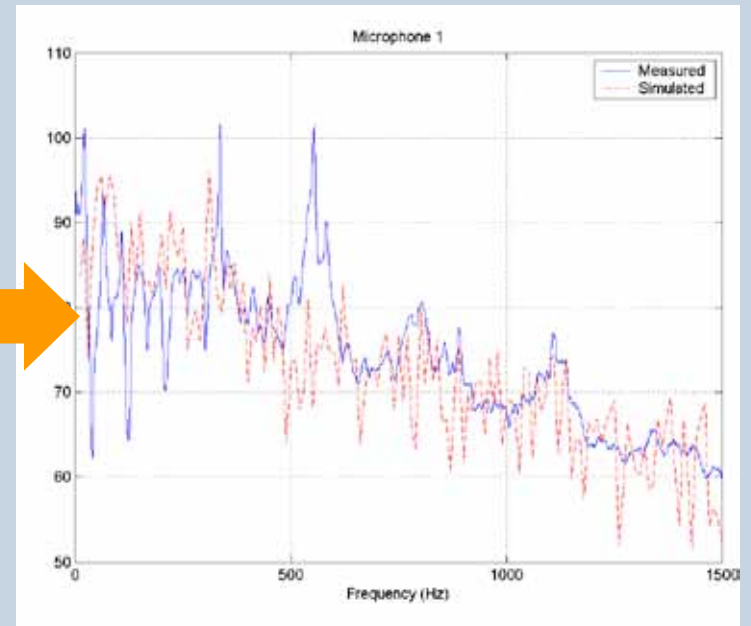


## Actran Model



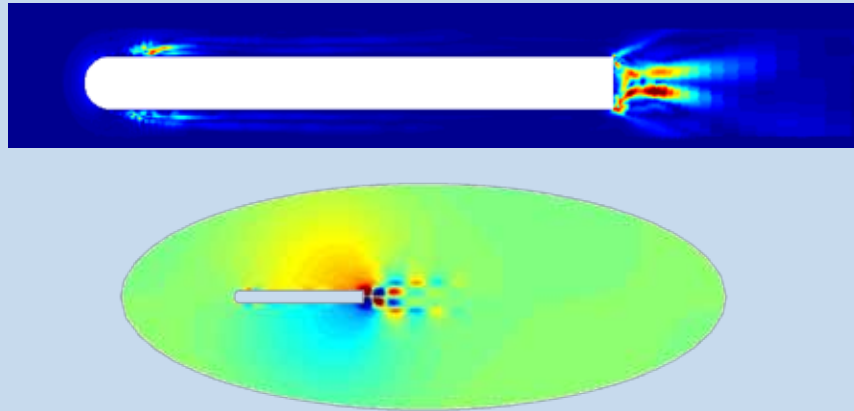
“Free” modal basis - NRBC

## Results

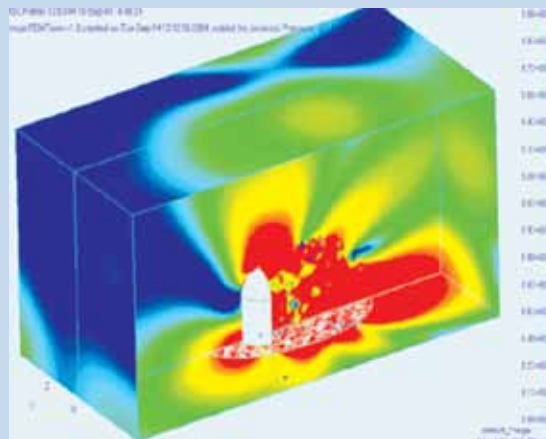


# その他の例

Example – Simple Plate



Example – Side Mirror



# 応用: 単純化された HVAC

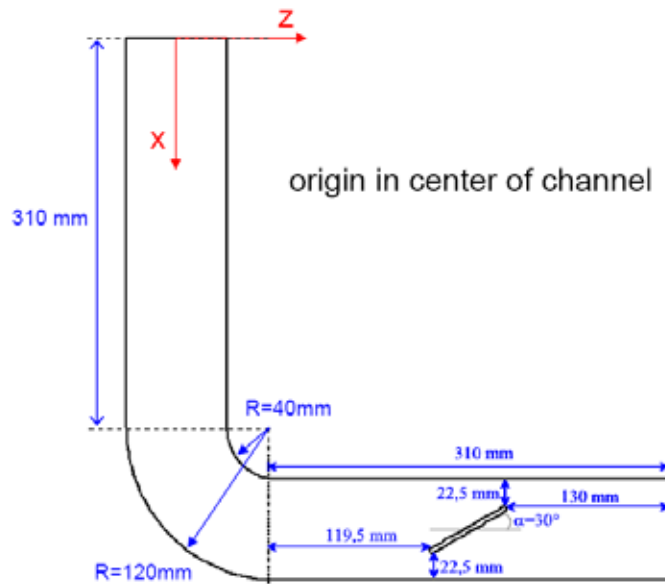


DAIMLER



# German Aeroacoustics Consortium

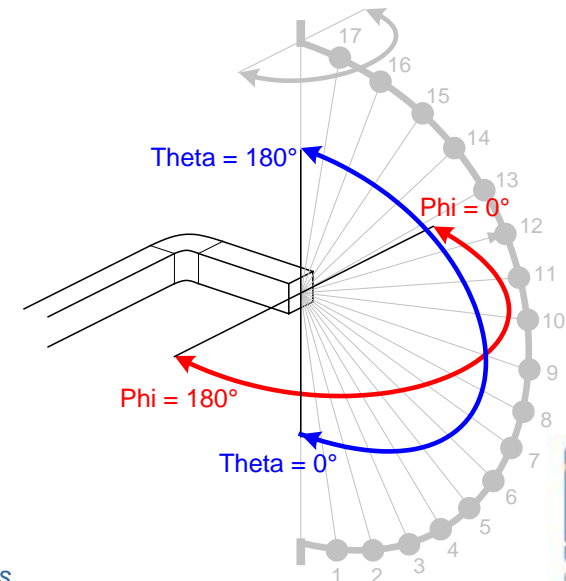
Ü Daimler, Audi, VW, BMW, Porsche が参加



Ü 計測 (@Dornier)

Ü CFD : star-CD 結果, LES-type

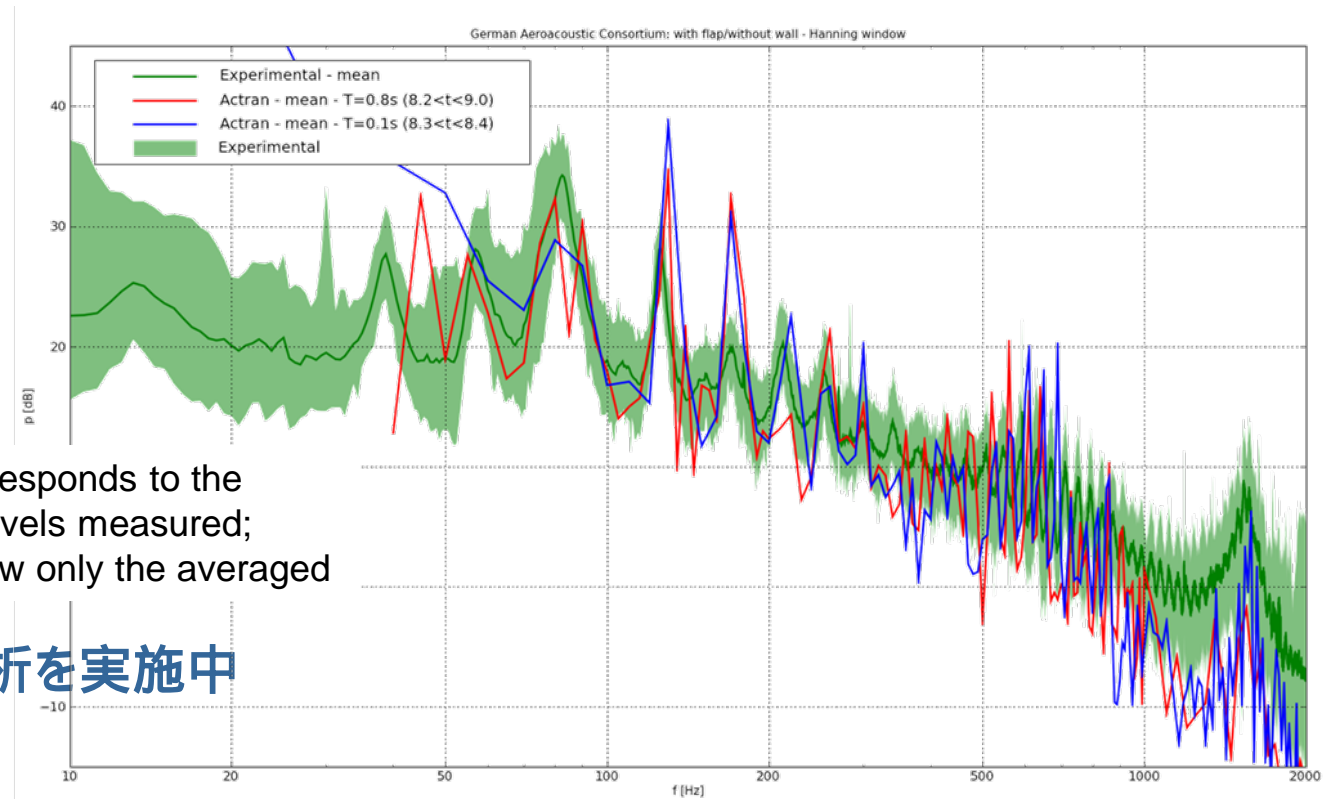
Ü Actranで音響解析



# 結果

Ü 多くの実験と解析が実施された(ex: 風洞のモデル化が非常に重要)

Ü 現在の結果:



The green envelope corresponds to the min, max and averaged levels measured;  
The numerical curves show only the averaged

Ü 現在さらなる解析を実施中

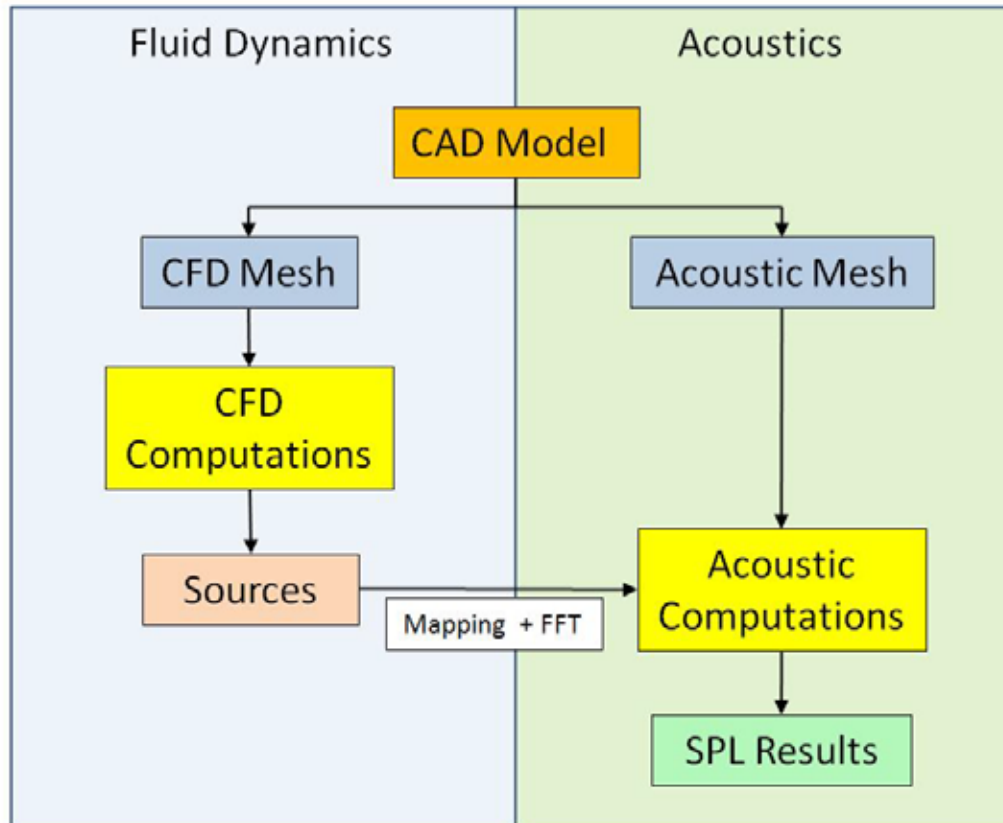
# 応用: インパネのダクト



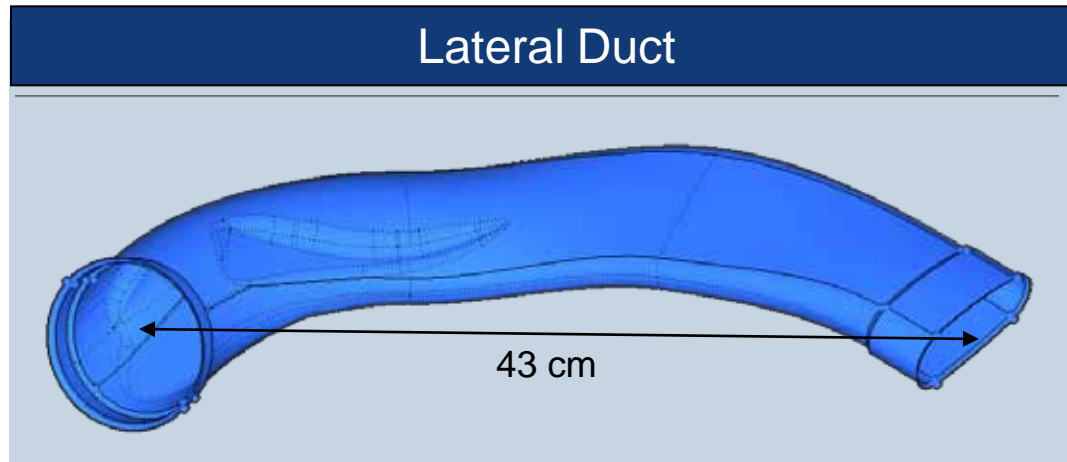
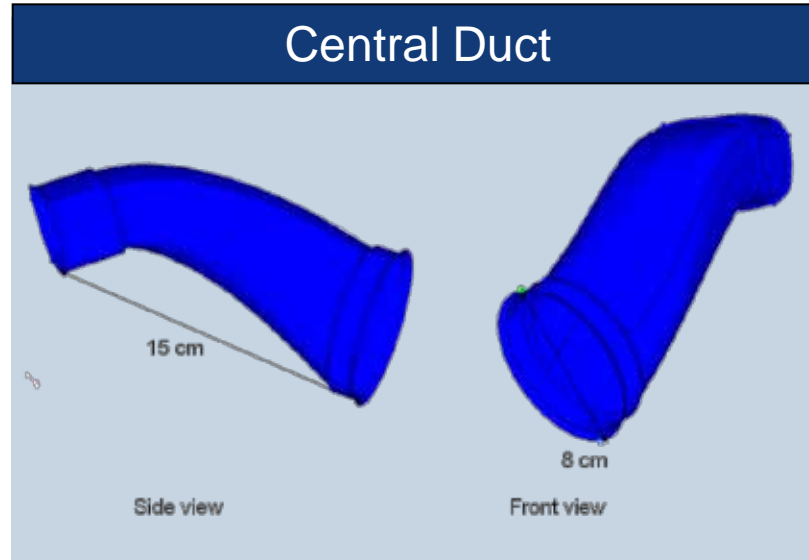
## Case Study Description



# プロセスの概要



# テストケース

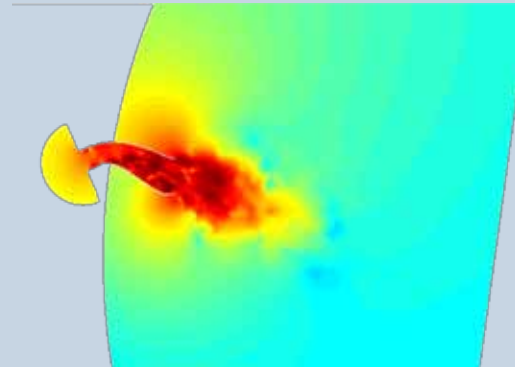


# 中央のダクト

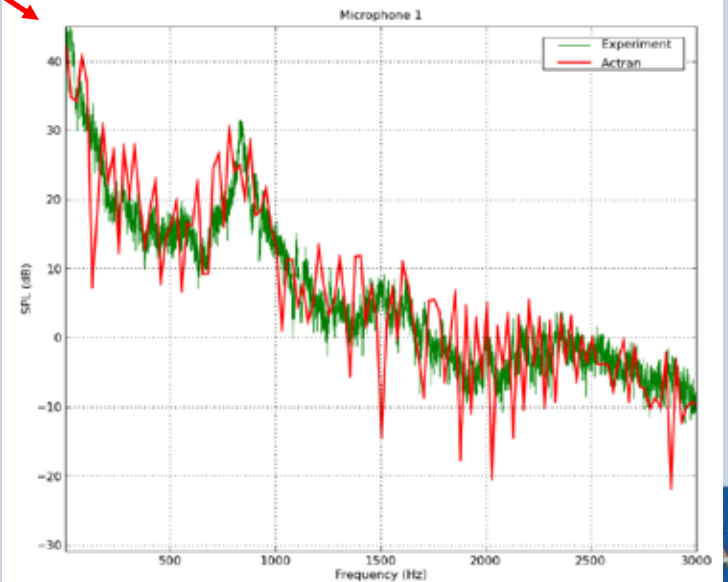
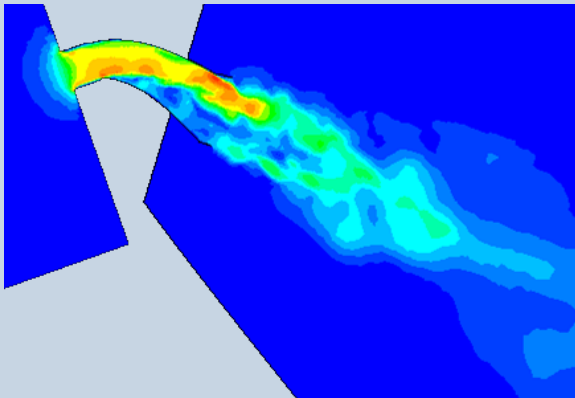
## Experimental Set-Up



## ACTRAN Results



## CFD Results - Fluent

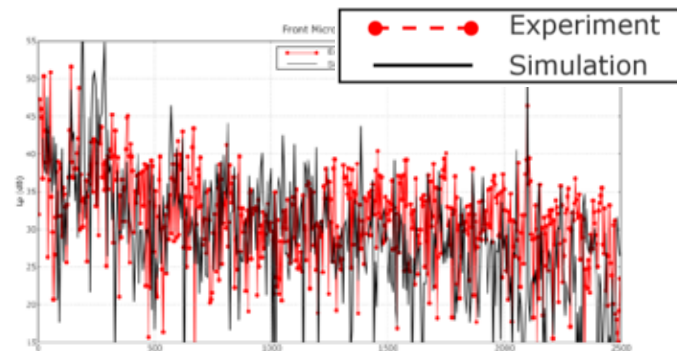
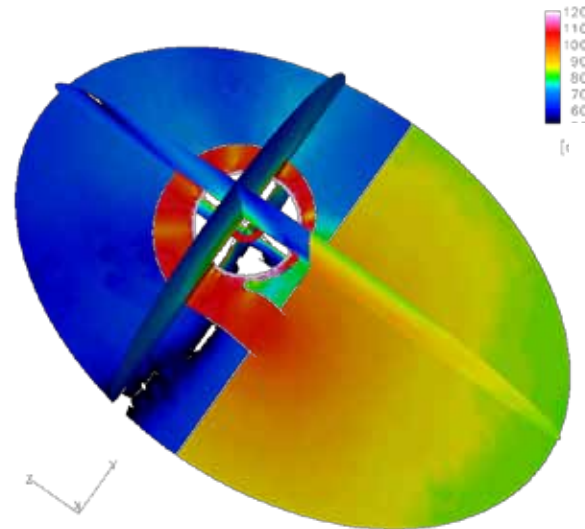
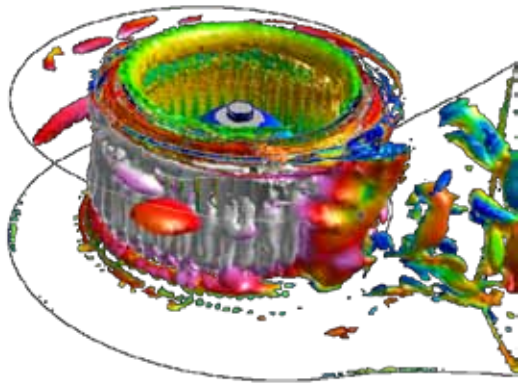


# 応用: ファン

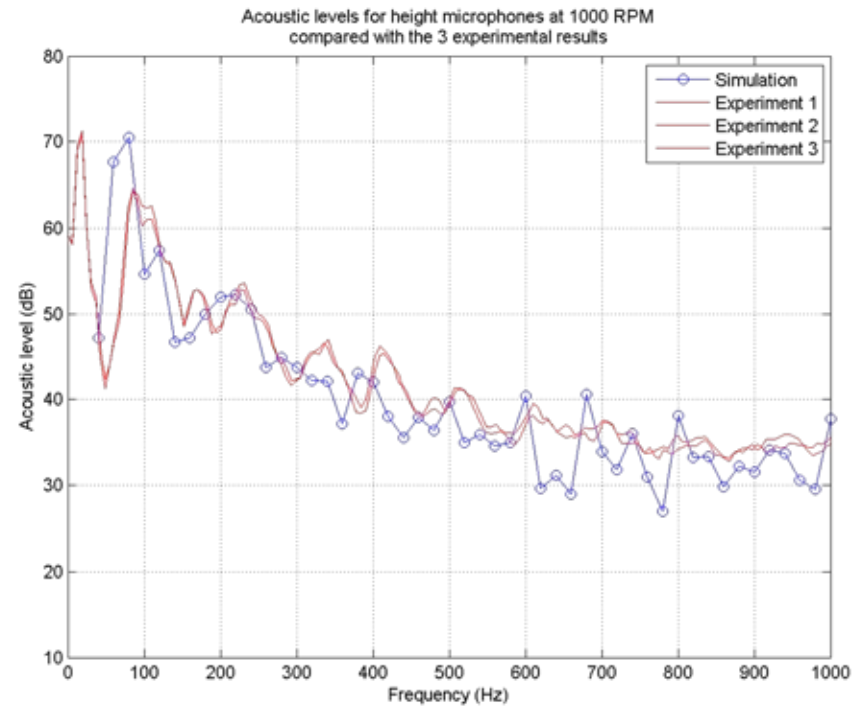
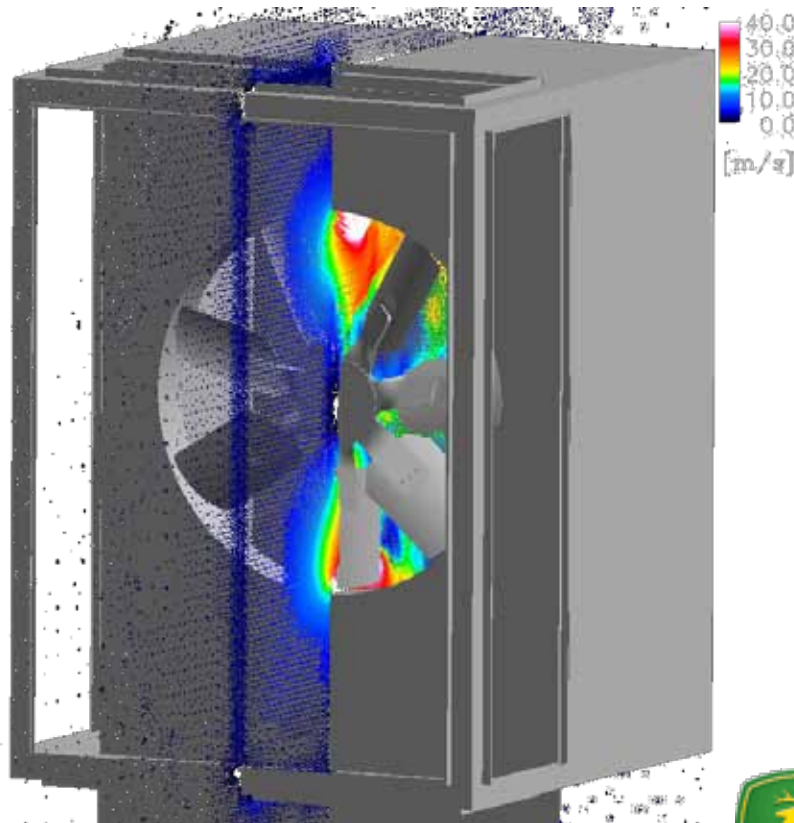


# HVAC ブローアー

Fan Noise 2007: Presentation of a CAA formulation based on Lighthill's analogy for fan noise - S. Caro, Y. Nishio, R. Sandboge, J. Iyer



# ファン騒音



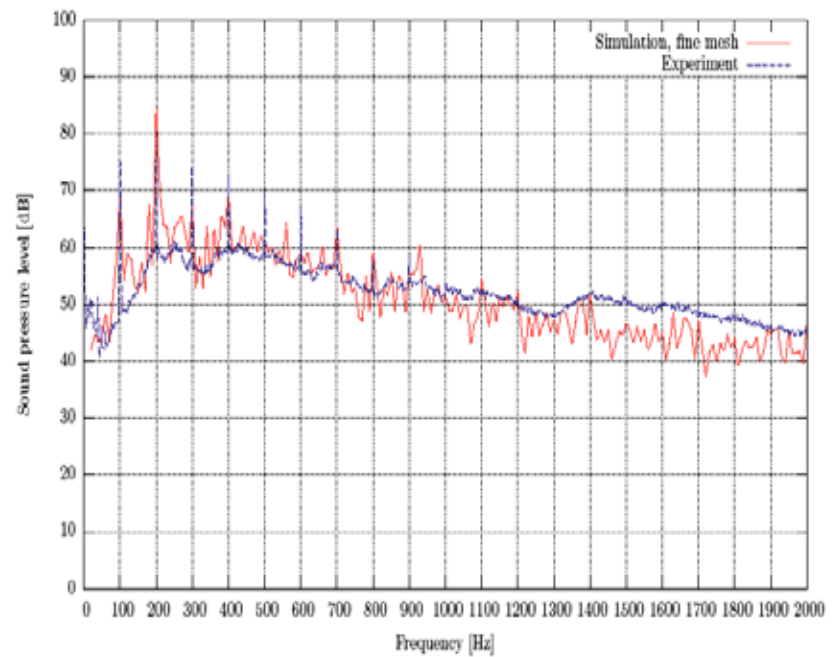
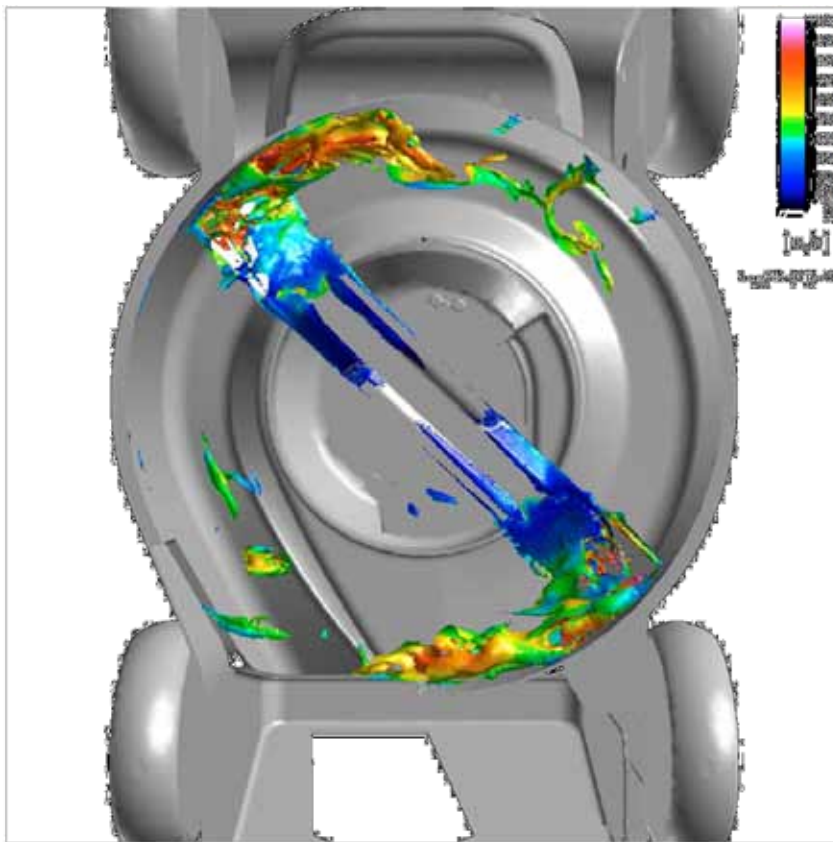
JOHN DEERE



FREE FIELD TECHNOLOGIES

# 芝刈り機の騒音

## Ü Lighthill 音源の可視化



JOHN DEERE



# 構造との連成の応用

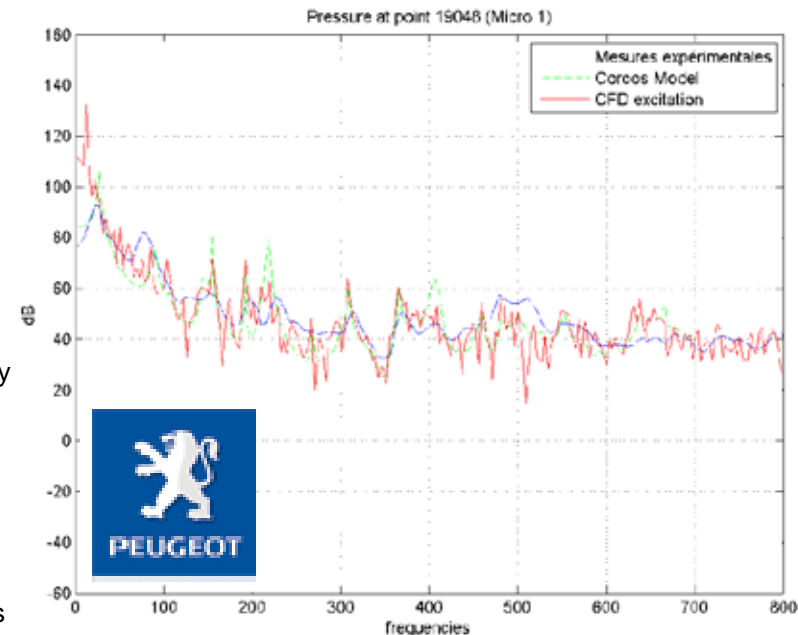
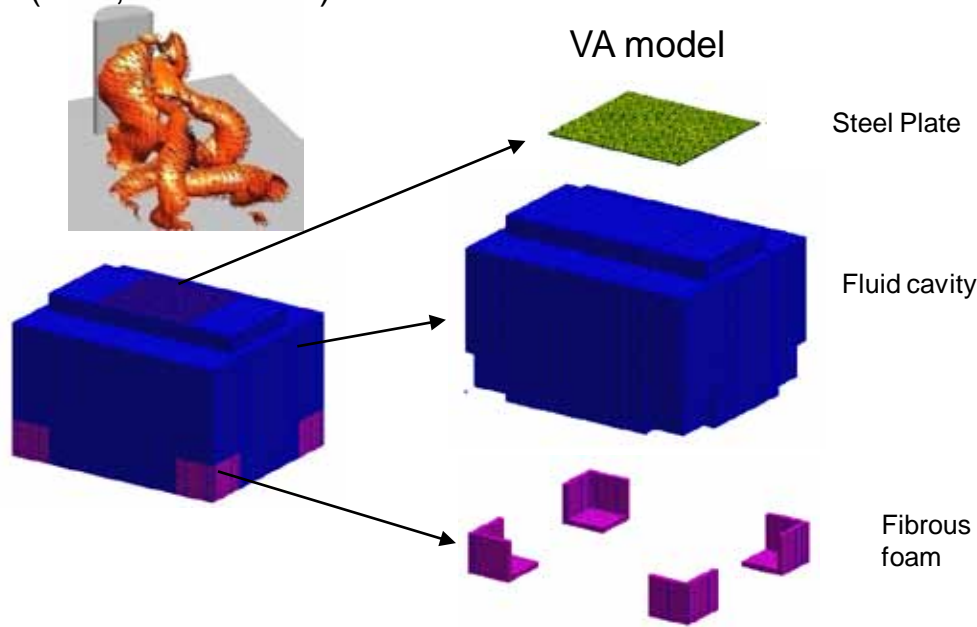


# サイドミラーノイズ: 簡易モデル

## Ü 簡易モデル, しかし現実的

- § ウィンドをモデル化したプレート
- § キャビティとウィンドは現実的なサイズ
- § シートをモデル化するフォーム材

CFD-computed excitation  
(here, Fluent LES)



AIAA06-2490: TBL Noise generated by a simplified side mirror configuration and acoustic transfer through the window: modelling using Actran and Fluent - S.Caro, A.Ramonda, FFT;



# 他の応用

- Û ランディングギアー
- Û サンプルーフ
- Û Aピラー
- Û 排気系