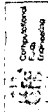


2005년도 유체기계공학회 연구개발 발표회
 2005. 12. 1(목)~2(금)
 창원대학교

축류송풍기 의형의 설계최적화

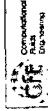
서 승 찬; 최 승 환; 김 광 중...
 (주) 삼성전자 개발혁신센터
 (주) 케이피코 시스템융합...
 인하대학교 기계공학과



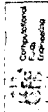
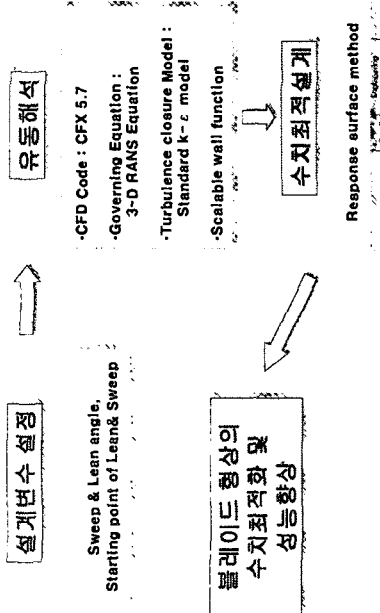
Purpose of research

축류송풍기의 효율향상을 위한 수치최적설계

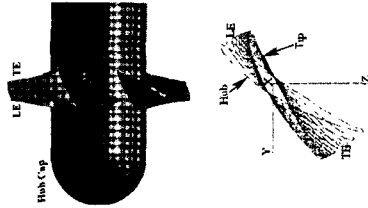
- 심치된 RANS 해석을 이용한 축류송풍기의 유동장 수치해석
- 실험데이터와 비교, 타당성 검증
- 유동특성 분석
- 반응면기법(Response Surface Method)
- 전압효율의 최대화



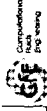
Research Procedure



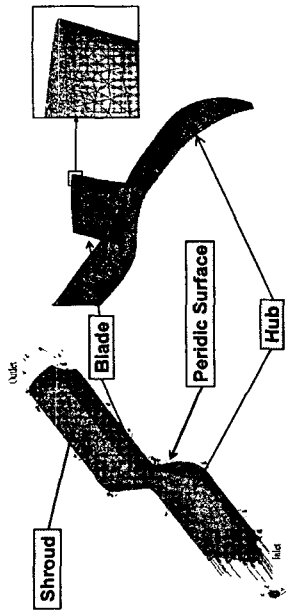
Axial Fan Geometry



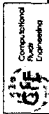
Flow Coefficient	0.41
Total Pressure Coefficient	0.3
Rotor Rotation Frequency	1000 rpm
Tip Radius	287.5 mm
Hub-Tip Ratio	0.52
Inlet Angle at Rotor Tip	68.8 °
Outlet Angle at Rotor Tip	63.8 °



Computational Grids



노드 수 : 3.0X10⁵

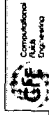


Objective Function

진입흐름

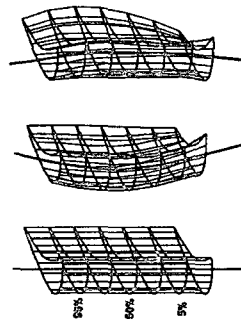
- $P_{t,out} - P_{t,in}$: 전압상승
- Q : 유량
- τ : 토크
- ω : 회전속도

$$\eta = \frac{(P_{t,out} - P_{t,in}) \times Q}{\tau \times \omega}$$

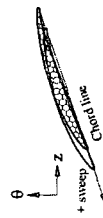


Design Variables

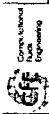
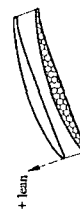
Structural grids



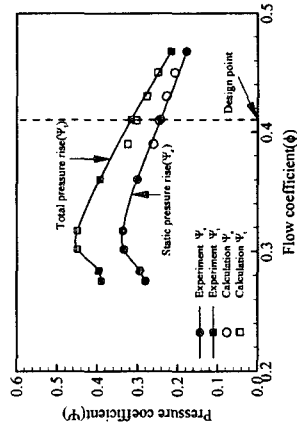
Shear angle



Lean angle



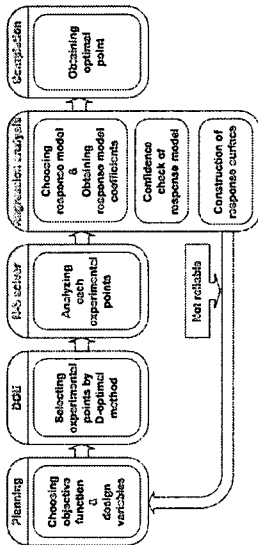
Validation



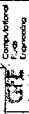
Comparison of pressure rise between exp. And cal. of the reference fan



Response Surface Method



Optimization Process Using RSM



Response Surface Method

2차 다항식 반응모델

$$\hat{y} = c_0 + \sum_{j=1}^k c_j X_j + \sum_{j=1}^k c_{jj} X_j^2 + \sum_{j < l} c_{jl} X_j X_l$$

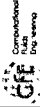
\hat{y} : the response model

X_j : design variable

c_j : unknown polynomial coefficient

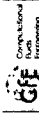
k : number of variables

number of c_i , $p = (k+1)(k+2)/2$

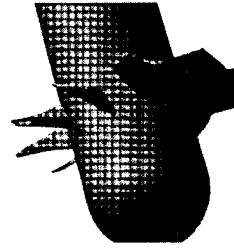


Optimization Result

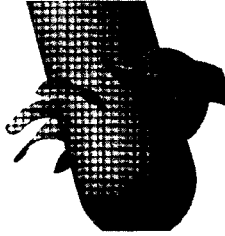
	Efficiency (%)	Increment (%)
Reference	85.10	-
Optimum with sweep and lean	86.85	1.75
Optimum with sweep only	86.35	1.25
Optimum with lean only	86.43	1.33



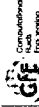
Blade Geometry Comparison



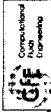
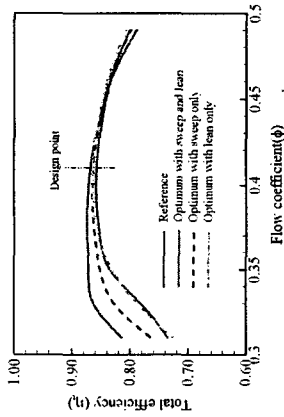
Initial Blade



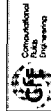
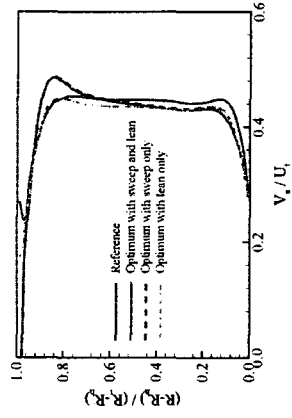
Optimized Blade



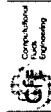
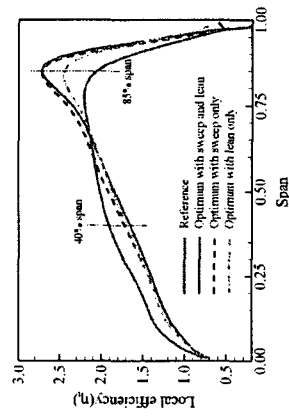
Total Efficiency



Axial Velocity at TE



Local Efficiency at TE



Flow Field Around Tip Area

