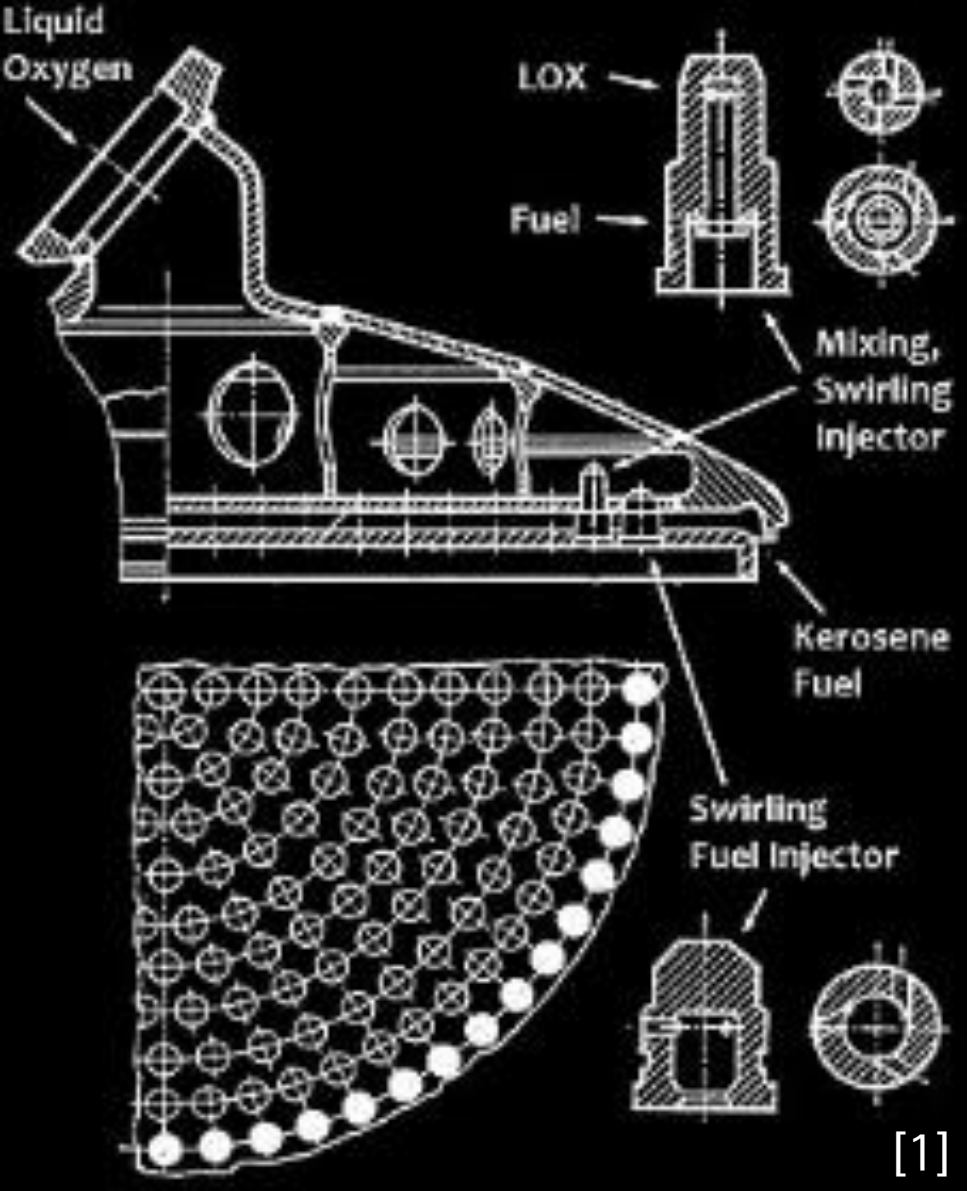


interFoam을 이용한 와류 분사기 유동 해석

NEXTfoam 김재열

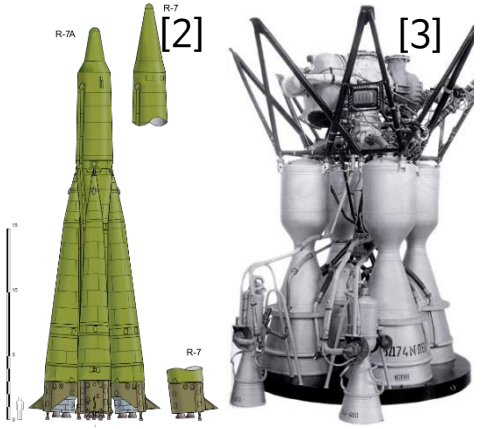
목 차

- 해석 대상 및 solver 소개
- 해석 조건
- 해석 결과 및 분석
- References

와류 분사기 및 interFoam solver

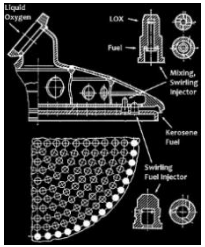
해석 대상 및 solver 소개

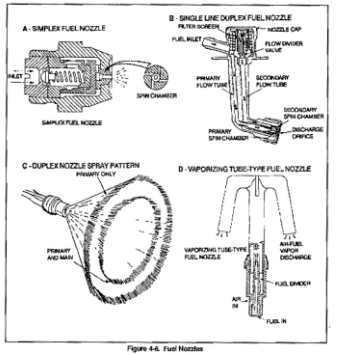
- Rocket engine Injector
  - Film cooling용
- 터빈 엔진 연료 분사기
- 도색용 분사기
- 서울대 상압 수류 실험 와류 분사기 (정연재 등)
- interFoam
  - OpenFOAM 2.4.0 다상유동 해석용 기본 제공 solver
  - 비압축성 유동 해석, VOF Method



[2]

[3]





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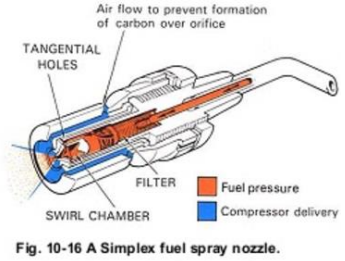


Fig. 10-16 A Simplex fuel spray nozzle.

[5]

해석 영역 및 유동 조건 설정

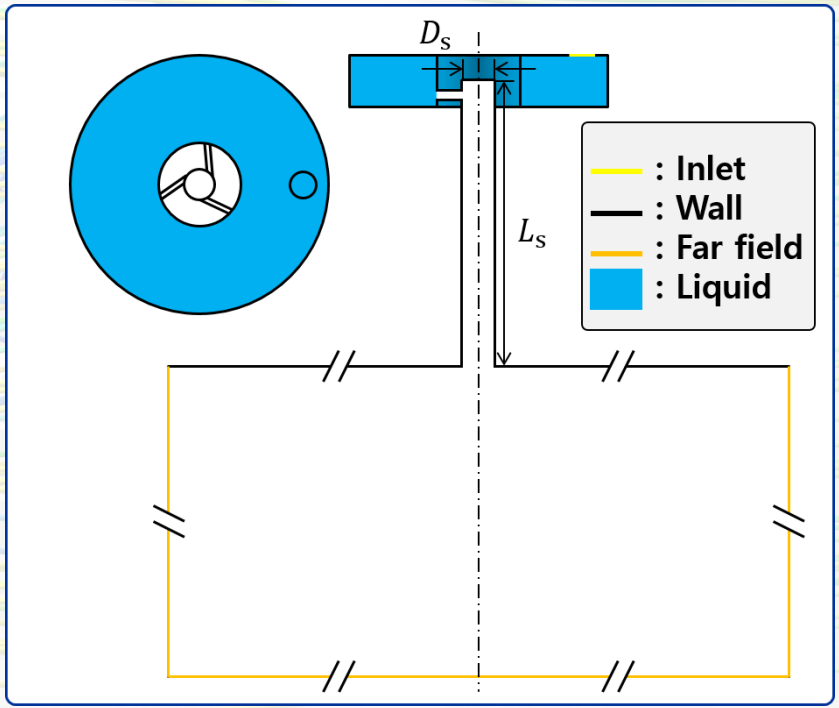
해석 조건

- Computational Domain

$$L_s = 55\ \text{mm}, D_s = 6\ \text{mm}$$

- Flow Condition
  - Liquid Tank Pressure: 5 bar
  - Ambient Pressure: 1 atm

Boundary Condition	
Inlet	Fixed static pressure and flow rate
Wall	No-slip condition
Far field	Fixed total pressure

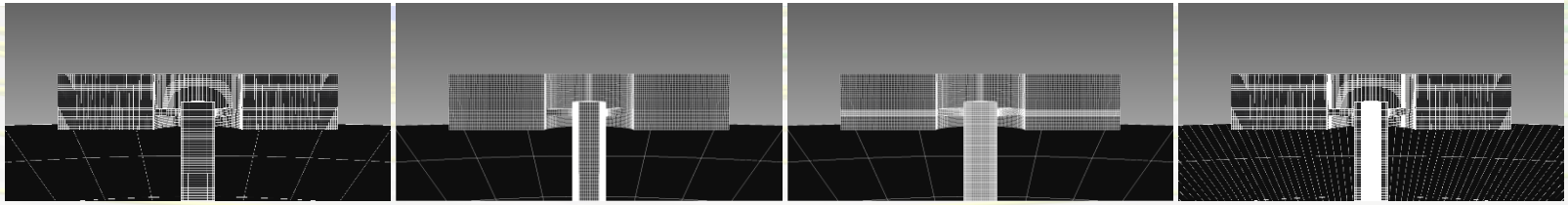


케이스별 격자

해석 조건

- 격자생성: blockMesh
- 검증 케이스: 32 million cells
- 격자 영향 확인용 케이스

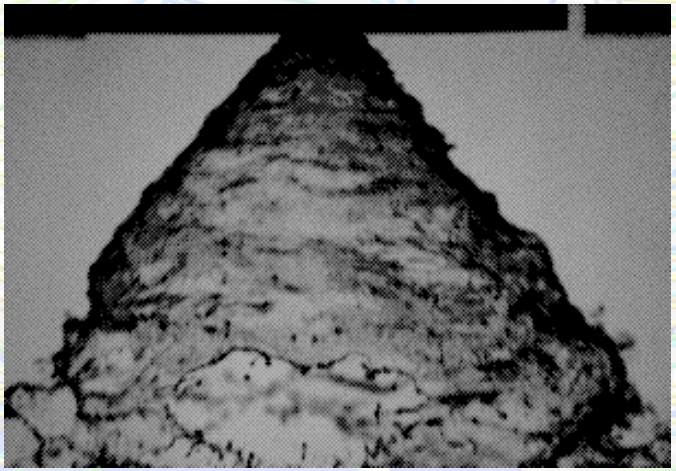
	Base	Case1	Case2	Case3
# of cells (million cells)	1	1.4	1.3	7.8
Circular angle (degree)	7.5			1
Radial Edge Length (μm)	100	33		
Axial Edge Length (μm)	250		100	



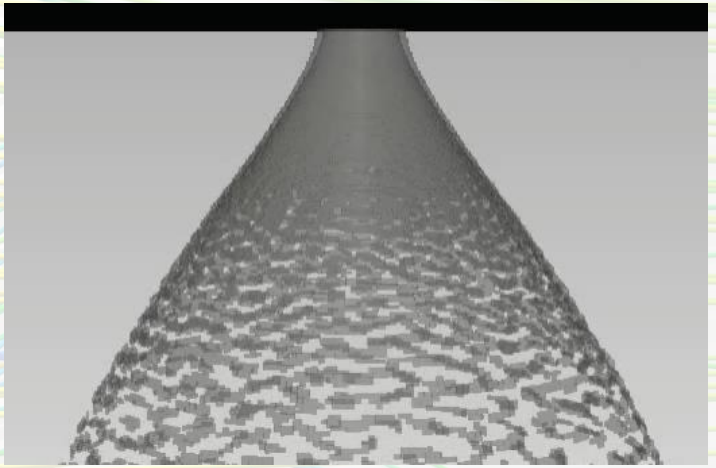
해석 결과 검증: 분무 특성 예측

해석 결과 및 분석

- 실험 결과와의 비교



Experiment



CFD

- 액적 예측을 위해서는 분사기 하부 격자 수준의 향상이 필요

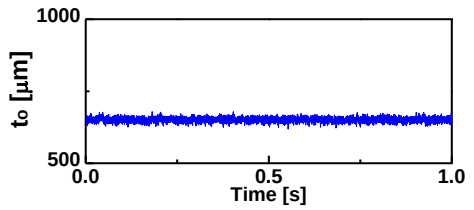
해석 결과 검증: 분사기 내부 액막 거동

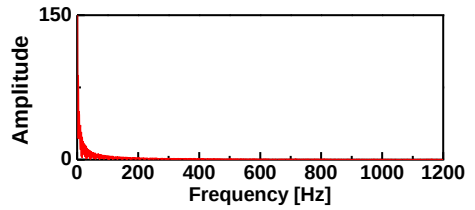
해석 결과 및 분석

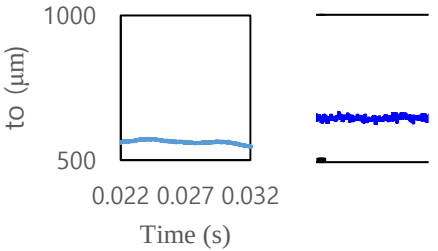
- 실험 결과와의 비교
  - 평균 액막 두께 오차: 15%

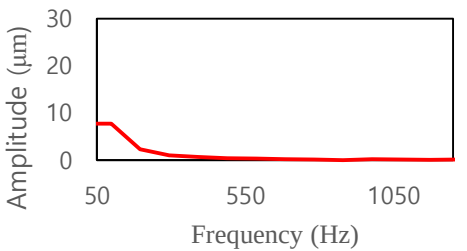
Mean Film Thickness	Experiment	CFD
	650 μm	553 μm

- 액막 진동 및 주파수 예측
  - 진폭 약 10 μm 로 유사
  - 주파수 경향





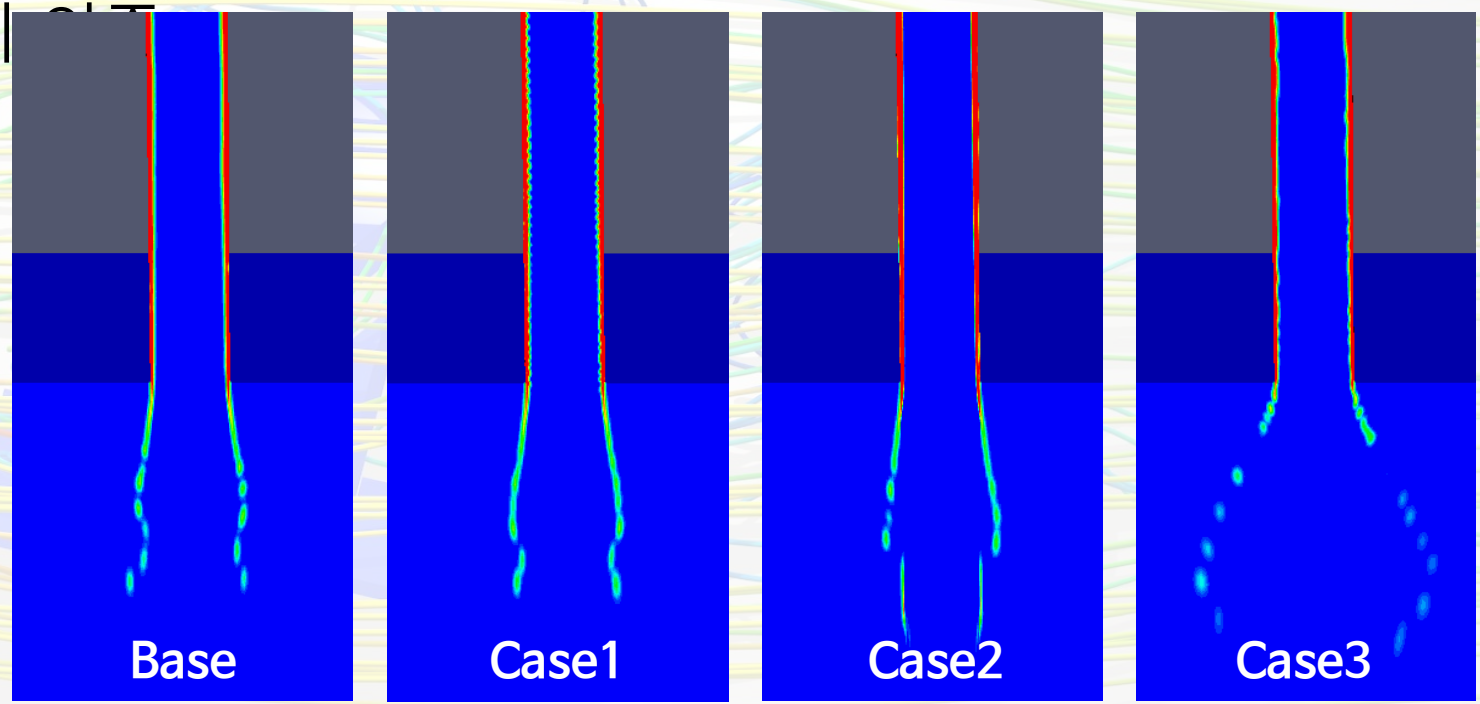




격자 영향 분석

해석 결과 및 분석

- 분무각 예측 시 각 방향 격자의 영향: 원주 방향 격자 수준에 의존



References

[1] RD-107 injector plate, http://mentallandscape.com/S_R7.htm

[2] R-7 Semyorka, https://en.wikipedia.org/wiki/R-7_Semyorka#/media/File:R-7_(7A)_misil.svg

[3] RD-107 engine, http://mentallandscape.com/S_R7.htm

[4] Fuel Nozzle, http://free-ed.net/sweethaven/MechTech/Aviation/ch04.htm

[5] Fuel Spray Nozzle, http://aeromodelbasic.blogspot.kr/2012/02/fuel-spray-nozzles.html