

## Baram v5 무엇에 쓰는 프로그램인가?



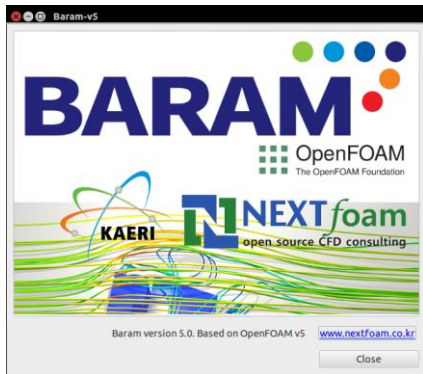
2018. 11. 01. (주)넥스트폼 김병윤, 길재흥, 박성현

# 목 차

- What is Baram?
- 개발 배경
- 현재 상황 / 한계
- v5 개발 방향
- Baram-v5 소개
- 결론

# What is Baram?

- OpenFOAM® 기반의 비압축성유동/열전달 해석 패키지
  - Not Graphic User Interface only
- 공개소스 프로그램 GNU GPL

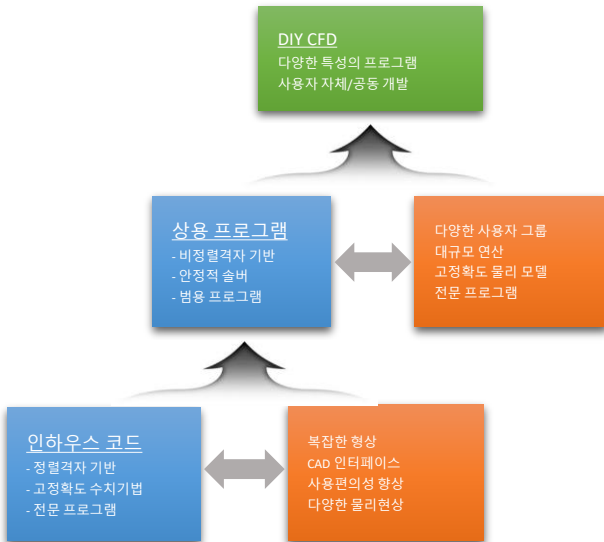


# 개발 배경

- 오픈폼의 부족한 부분 보완
  - 사용 편의성 확보
  - 사용자 확대
  
- DIY CFD의 기본 프레임

- 오픈폼의 부족한 부분
  - 슬버
    - 좋지 않은 격자에서 안정성/정확성의 문제
    - 초기조건에 민감한 문제
  - 사용 방법의 복잡함
    - 많은 파일에서 경계조건 설정
    - 복잡한 수치해석 기법 설정
    - 복잡한 데이터 추출 / 모니터링 방법
  - 익숙하지 않은 사용자 환경
    - OS, 에디터
- 보완 방법
  - 오픈폼 코드 수정
  - 그래픽 환경 개발

# 개발 배경 – DIY CFD 기본 프레임



## 현재 상황 / 한계

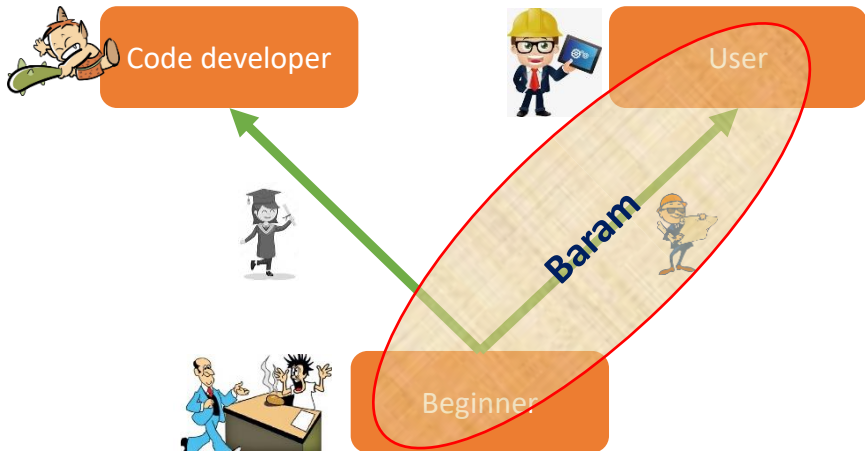
- 거의 아무도 쓰지 않는 것 같은...
  - 제한된 솔버
  - 많은 버그
  - 뭔가 불편한 GUI
  - Windows 에서는...
  - 정리되지 않은 UI 소스코드
  - 해마다 바뀌는 다양한 오픈폼 버전
  
- 어떤 사람이 쓸만한 것일까?

# V5 개발 방향

- 대상 사용자 – Beginner to User
  - 설정 단순화
  - Standard solver, rhoReactingFoam 삭제
  - 텍스트 에디터 삭제
- OpenFOAM 5
- 데이터 처리시간 줄이기
- 그래픽 기능 향상
- Microsoft Windows



# V5 개발 방향 - 오픈폼의 사용자 층



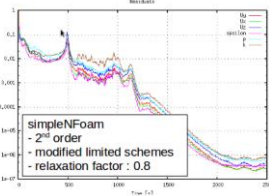
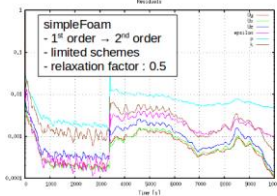
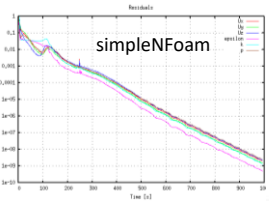
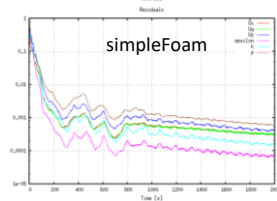
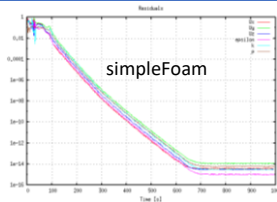
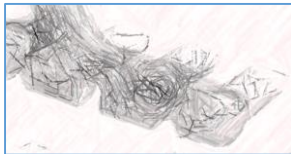
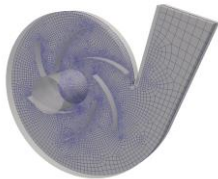
# Baram v5 소개

- 코드 개발 - nextfoam

- 솔버 : 안정성, 정확성
- 수치해석 기법 개선
- 난류모델, 경계조건, 유틸리티...
- 솔버 설정 방식의 단순화
  - 경계조건 설정 방법 변경
  - 수치해석 기법 설정 단순화
  - 디폴트 조건 설정
  - AMI 설정 단순화
- 탑재된 솔버
  - simpleNfoam / pimpleNfoam
  - buoyantSimpleNfoam / buoyantPimpleNfoam

- **createCase** -case <folder> <solver>
- [mesh import]
- **createSettings**
- [initial/boundary/numericalConditions 파일 수정]
- **setConditions**
- run
- **setConditions**
- run

# Baram v5 소개 - 비압축성 유동 솔버 평가 사례



## Baram v5 소개 - 경계조건

- velocityInlet
- surfaceNormalVelocityInlet
- massFlowRateInlet
- volumeFlowRateInlet
- pressureInlet
- pressureOutlet
- adiabaticWall
- isoThermalWall
- heatFluxWall
- convectionWall
- thermoCoupledWall
- internalInterface
- rotationalPeriodic
- translationalPeriodic

# Baram v5 소개 - 디폴트 조건

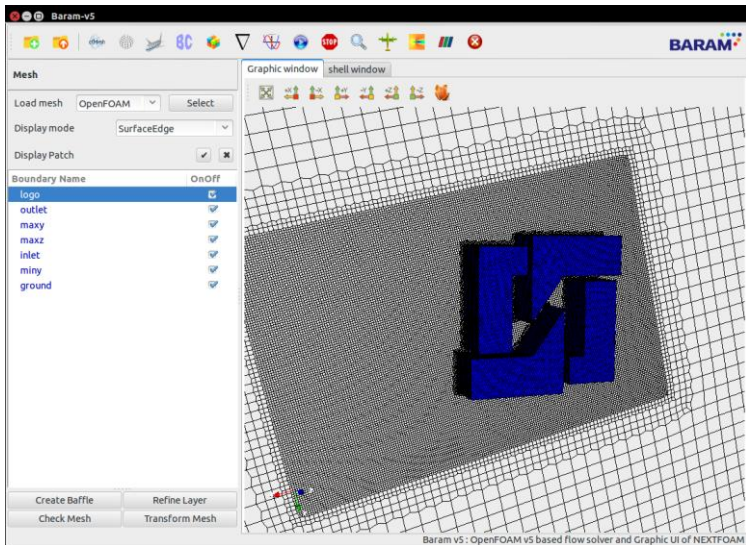
- fvSchemes

- ddt
  - NEXT::Euler
- div(phi,U)
  - Gauss linearUpwind limitedGradient  
(NEXT::VKLimited Gauss linear 1)
- laplacian
  - Gauss linear NEXT::corrected
- interpolate(p)
  - NEXT::momentumWeighted
- snGrad
  - NEXT::corrected

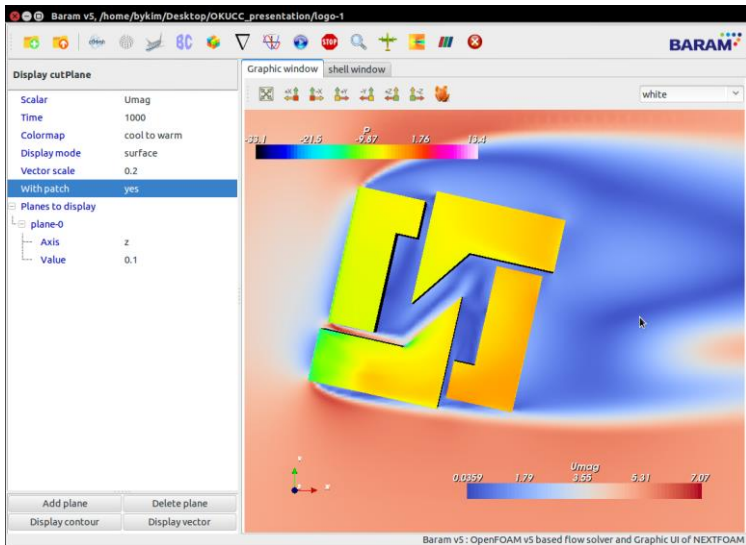
- fvSolution

- solvers.p
  - solver PCG
  - preconditioner GAMG
- solvers.U, k, epsilon...
  - solver PBiCGStab
  - preconditioner DILU
- solvers.h
  - solver PBiCGStab
  - preconditioner GAMG
- PIMPLE
  - nCorrectors 2
  - nOuterCorrectors 20
  - relTol 0.05

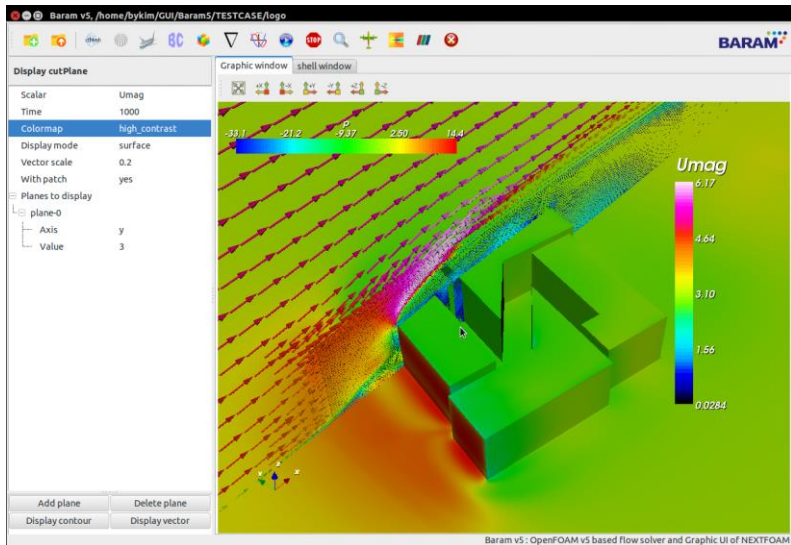
# Baram v5 소개 - GUI 환경



# Baram v5 소개 - GUI 환경



# Baram v5 소개 - GUI 환경





# Baram v5 소개 - GUI 환경



**Mesh**

Local mesh: OpenFOAM | Select

Display mode: Surface

Display Mesh: [Icons]

Boundary name: [List]

Physics

|                  |                |
|------------------|----------------|
| Time advance     | Transient      |
| Energy           | label transfer |
| Turbulence model | kEpsilon       |
| Gravity          | 0              |

Material Properties

|                      |         |
|----------------------|---------|
| density_method       | CONSIST |
| density              | 1.225   |
| transport_method     | CONSIST |
| viscosity            | 1e-5    |
| thermal conductivity | 0.0245  |
| cp                   | 800     |

Radiation Properties

|                |     |
|----------------|-----|
| radiationModel | P1  |
| solveFrequency | 1   |
| absorptivity   | 0.5 |
| emissivity     | 0.5 |
| ε              | 0   |
| wallEmissivity |     |
| lago           | 1.0 |
| ground         | 1.0 |

**Flow Conditions**

Initial Conditions

|                     |       |
|---------------------|-------|
| velocity            | 0 0 0 |
| Pressure            | 0     |
| Temperature         | 300   |
| alphaViscosity      | 1     |
| turbulenceIntensity | 0.001 |
| viscosityRatio      | 10    |

Boundary Conditions

|          |                |
|----------|----------------|
| lago     | adiabaticWall  |
| outlet   | pressureOutlet |
| inlet    | symmetry       |
| inlet2   | symmetry       |
| inlet3   | symmetry       |
| inlet4   | symmetry       |
| inlet5   | symmetry       |
| inlet6   | symmetry       |
| inlet7   | symmetry       |
| inlet8   | symmetry       |
| inlet9   | symmetry       |
| inlet10  | symmetry       |
| inlet11  | symmetry       |
| inlet12  | symmetry       |
| inlet13  | symmetry       |
| inlet14  | symmetry       |
| inlet15  | symmetry       |
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| inlet96  | symmetry       |
| inlet97  | symmetry       |
| inlet98  | symmetry       |
| inlet99  | symmetry       |
| inlet100 | symmetry       |

Numerical Conditions

Discretization schemes

|            |             |
|------------|-------------|
| time       | Fractional  |
| momentum   | secondOrder |
| energy     | secondOrder |
| turbulence | fractional  |

Relaxation Factors

|            |     |
|------------|-----|
| pressure   | 0.3 |
| momentum   | 0.7 |
| energy     | 0.9 |
| turbulence | 0.1 |

Convergence criteria

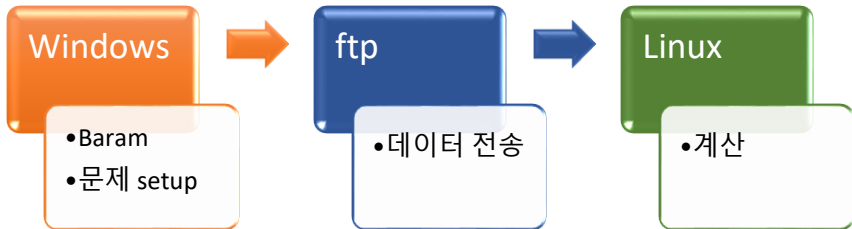
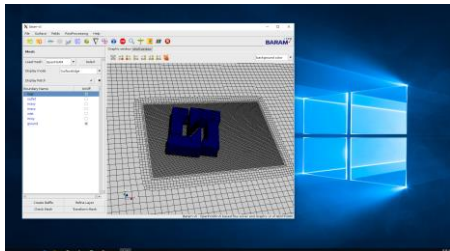
|                      |       |
|----------------------|-------|
| pressure             | 0.001 |
| momentum             | 0.001 |
| energy               | 0.001 |
| turbulence           | 0.001 |
| pressure_relative    | 0.65  |
| momentum_relative    | 0.05  |
| energy_relative      | 0.05  |
| turbulence_relative  | 0.05  |
| Max iter & longer ok | 10    |

**Run Conditions**

|                  |                   |
|------------------|-------------------|
| startFrom        | latestTime        |
| endTime          | 1000              |
| deltaT           | 1                 |
| adjustTimeStep   | no                |
| writeControl     | adjustableRunTime |
| writeInterval    | 500               |
| purgePoints      | 0                 |
| writePrecision   | 6                 |
| timeFormat       | general           |
| timePrecision    | 6                 |
| writeFormat      | binary            |
| writeCompression | no                |
| nCases           | 1                 |
| machineType      | SMP               |
| platformDual     | yes               |

# Baram v5 소개 – Microsoft windows

- Windows subsystem Ubuntu
- Xming 서버를 통한 X window
- 정리가 안된...
- 업무 프로세스



# Baram v5 소개 - v5 기능 요약

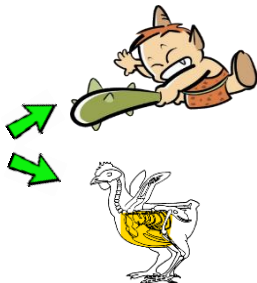
- 솔버 : 정상/비정상상태. 비압축성/열전달
  - simpleN Foam / pimpleN Foam
  - BuoyantSimpleN Foam / buoyantPimpleN Foam
- Mesh
  - Generate : snappyHexMesh, cfMesh
  - Mesh convert : Fluent, StartCCM+, gmsh, ideas unv
  - Utility : checkMesh, createBaffle, refineWallLayer, transformPoints
  - Create interface
- Cell zone
  - MRF, porous, heat source
- Monitoring / data extraction
  - Force, force coefficient
  - Point value
  - Surface average, integrate, flow rate
- Field utility
  - setFields, mapFields, Q, vorticity, yPlusRAS

- Baram, 무엇에 쓰는 프로그램인가?

- Beginners to User
- 오픈폼에 쉽게 접근
- 설정을 조금 편하게
- DIY CFD의 기본 프레임으로

- 추후 계획

- Bug fix
- 예제 추가
- GUI code 정리
- 윈도우에서 편하게...

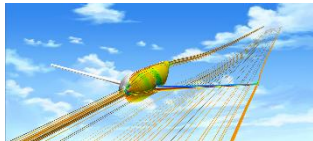


# 덧붙여...



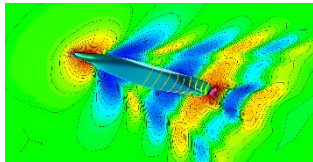
고속 압축성 공력해석 전용 프로그램  
2개 솔버

- 밀도 기반 솔버 : TSAeroFoam
- 압력 기반 솔버 : PCNFoam



Estimating Ship Performance  
선박 유동해석 전용 프로그램

- POW(Propeller Open Water Test)
- Resistance : double body / free surface / 6DOF
- Self propulsion : body force, MRF, Sliding





**감사합니다.**