FrontISTR Ver.5.1 CheatSheet(2020/08/24)

FrontISTR
Large-scale Parallel Finite Element Analysis Open Software on HEC-MW

Install

```
$ tar xzf FrontISTR-v5.1.tar.gz
$ cd FrontISTR-v5.1
$ mkdir build; cd build
$ cmake .. -
DCMAKE_INSTALL_PREFIX=$HOME/local
$ make -j2; make install
```

Parallel Execution

```
$ hecmw_part1
$ mpirun -np <4> fistr1
```

Input

File Type	File Name
Overall Control Data	hecmw_ctrl.dat
Mesh Data	.msh
Analysis Control Data	.cnt
Partitioning Control Data	hecmw_part_ctrl.dat

Output

File Type	File Name
Log File	<0>.log
Analysis Result File	.res.<0>.
Visualization File	_vis_psf..pvtu

Overall Control Data (hecmw_ctrl.dat)

```
!MESH, NAME=part_in, TYPE=HECMW-ENTIRE
 <ModelName>.msh
!MESH, NAME=part_out, TYPE=HECMW-DIST
 <ModelName>.p
!MESH, NAME=fstrMSH, TYPE=HECMW-DIST,
REFINE=<1>
 <ModelName>.p
!CONTROL, NAME=fstrCNT
 <ModelName>.cnt
!RESTART, NAME=restart_in, IO=INOUT
 <ModelName>.restart
!RESULT, NAME=fstrTEMP, IO=IN
 <ModelName>.res
!RESULT, NAME=fstrRES, IO=OUT, TYPE=BINARY
 <ModelName>.res
!RESULT, NAME=vis_out, IO=OUT
 <ModelName>_vis
!SUBDIR, ON
```

Partitioning Control Data (hecmw_part_ctrl.dat)

```
!PARTITION, TYPE=NODE-BASED,
METHOD=PMETIS, DOMAIN=<4>
```

MeshData

```
!HEADER
 <TITLE>
!NODE
 <NODE_ID>, <x>, <y>, <z>
!ELEMENT, TYPE=<341>, EGRP=<E1>
 <ELEM_ID>, <node1>, <node2>, <node3>, ...
!MATERIAL, NAME=<STRMAT>, ITEM=<3>
!ITEM=1, SUBITEM=2
 <YoungModulus>, <PoissonRatio>
!ITEM=2
 <Density>
!ITEM=3
 <ExpansionCoeff>
!MATERIAL, NAME=<HEATMAT>, ITEM=<3>
!ITEM=1, SUBITEM=2
 <Density>, <Temperature>
!ITEM=2, SUBITEM=2
 <SpecificHeat>, <Temperature>
!ITEM=3, SUBITEM=2
 <Conductivity>, <Temperature>
!SECTION, TYPE=<SOLID>, EGRP=<E1>,
MATERIAL=<STRMAT>
!NGROUP, NGRP=<NG1>
 <node1>, <node2>, ...
!SGROUP, SGRP=<SG1>
 <elem1>, <localsurf1>, <elem2>, <localsurf2>, ...
!EGROUP, EGRP=<EG1>
 <elem1>, <elem2>, ...
!CONTACT PAIR, NAME=<CP1>
 <Slave_NodeGroup>, <Master_SurfaceGroup>
!AMPLITUDE, NAME=<AMP1>, VALUE=
<RELATIVE|ABSOLUTE>
 <value1>, <time1>, <value2>, <time2>, ...
!EQUATION
 <Num_terms>, <RHS>
 <NODE_ID>, <dof>, <coeff>, ...
!ZERO
 <AbsoluteZero>
!END
```

Version

```
!VERSION
 5
```

Static Analysis

```
!SOLUTION, TYPE=STATIC
!STATIC
!BOUNDARY,GRPID=<1>
 <NODE_ID>, <StartDOF>, <EndDOF>, <Value>
!CLOAD,GRPID=<1>
 <NODE_ID>, <DOF>, <LoadValue>
!DLOAD,GRPID=<1>
 <SGRP>, <LoadType>, <LoadParameter>
!SPRING,GRPID=<1>
 <NODE_ID>, <DOF>, <SpringConstant>
```

Contact

```
!CONTACT_ALGO, TYPE=
<SLAGRANGE|ALAGRANGE>
!CONTACT, GRPID=<1>, NTOL=
<NormalThreshold>, TTOL=<TangentThreshold>,
NPENALTY=<NormalPenalty>, TPENALTY=
<TangentPenalty>
 <ContactPair>, <FrictionCoeff>, <FrictionPenalty>
```

Thermal Stress

```
!REFTEMP
 <Temperature>
!TEMPERATURE, READRESULT=<ResultStep>,
SSTEP=<FirstStep>, INTERVAL=<StepInterval>
```

Eigen

```
!SOLUTION, TYPE=EIGEN
!EIGEN
 <NumOfEigenvalues>, <Allowance>,
<MaxIterations>
!BOUNDARY
```

Heat Conduction

```
!SOLUTION, TYPE=HEAT
!HEAT
 <DT>, <CalcTime>, <TimeIncrement>,
<Allowable>, <MaxIteration>, <Allowance>
!INITIAL_CONDITION, TYPE=<TEMPERATURE>
 <NODE_ID>, <Temperature>
!FIXTEMP
 <NODE_ID>, <Temperature>
!CFLUX
 <NODE_ID>, <HeatFlux>
!DFLUX
 <ELEMENT_ID>, <LoadType>, <HeatFlux>
!SFLUX
 <SGRP>, <HeatFlux>
!FILM
 <ELEMENT_ID>, <LoadType>,
<HeatTransferCoeff>, <AmbientTemp>
!SFLIM
 SGRP, <HeatTransferCoeff>, <AmbientTemp>
!RADIATE
 ELEMENT_ID, <LoadType>, <RadiationFactor>,
<AmbientTemp>
!SRADIATE
 SGRP, <RadiationFactor>, <AmbientTemp>
!WELD_LINE
 <Current>, <Voltage>, <HeatInput>,
<TorchSpeed>
 EGRP, <DOF>, <StartPoint>, <EndPoint>,
<TorchWidth>, <StartTime>
```

Dynamic Analysis

```
!SOLUTION, TYPE=DYNAMIC
!BOUNDARY
!CLOAD
!DLOAD
!SPRING
!VELOCITY, TYPE=<INITIAL|TRANSIT>, AMP=
<NAME>
 NODE_ID, <DOF>, <DOF>, <RestrictedValue>
!ACCELERATION, TYPE=<INITIAL|TRANSIT>, AMP=
<NAME>
 NODE_ID, <DOF>, <DOF>, <RestrictedValue>
!INITIAL_CONDITION, TYPE=
<VELOCITY|ACCELERATION>
 NODE_ID, <DOF>, value
```

Time History Response Analysis

```
!DYNAMIC, TYPE=<LINEAR|NONLINEAR>
 <ImplicitMethod1|ExplicitMethod11>, 1
 <StartTime>, <EndTime>, <NumberOfSteps>,
<TimeIncrement>
 <gamma>, <beta>
 <LumpedMass1|ConsistentMass2>, 1, <Rm>,
<Rk>
 1, <MonitoringNode>, <OutputInterval>
 <Displacement>, <Velocity>, <Acceleration>,
<Reaction>, <Strain>, <Stress>
```

Frequency Response Analysis

```
!DYNAMIC, TYPE=NONLINEAR
 <ImplicitMethod1|ExplicitMethod11>, 2
 <MinFrequency>, <MaxFrequency>,
<NumOfDivisions>, <MeasurementFrequency>
```

```
 <StartTime>, <EndTime>
 <LumpedMass1>, 1, <Rm>, <Rk>
 <ResultInterval>, <Mode1|TimeHistory2>,
<MonitoringNode>
 <Displacement>, <Velocity>, <Acceleration>, 0, 0,
0
!EIGENREAD
 <EigenAnalysisLog>
 <StartMode>, <EndMode>
!FLOAD
 NODE_ID, <DOC>, <LoadValue>
```

Analysis Step

```
!STEP, TYPE=<STATIC|VISCO>, SUBSTEPS=
<NumOfSubsteps>, CONVERG=<Threshold>,
MAXITER=<MaxIteration>
 <TimeIncrement>, <EndValueOfTimeIncrement>
 BOUNDARY, <GRPID>
 LOAD, <GRPID>
 CONTACT, <GRPID>
```

Auto Time Increment

```
!AUTOINC_PARAM, NAME=<AP1>
 <DecreaseRate>, <MaxIteration>,
<TotalIteration>, <ContactIteration>,
<NumOfDecreaseSubsteps>
 <IncreaseRate>, <MaxIteration>, <TotalIteration>,
<ContactIteration>, <NumOfIncreaseSubsteps>
 <CutbackRate>, <NumberOfCutbacks>
!TIME_POINTS, NAME=<NameofList>, TIME=
<STEP|TOTAL>
 <TIME>
!STEP, TYPE=<STATIC|VISCO>, SUBSTEPS=
<MaxSubsteps>, CONVERG=<Threshold>,
MAXITER=<MaxIteration>, INC_TYPE=AUTO,
MAXRES=<MaxAllowance>, TIME_POINTS=
<NameOfTimeList>, AUTOINCPARAM=
<NameOfAutoIncrementParameter>,
MAXCONTITER=<ContactIteration>
 <InitialTimeIncrement>, <StepIncrement>,
<UpperLimitOfTimeIncrement>,
<LowerLimitOfTimeIncrement>
 BOUNDARY, <GRPID>
 LOAD, <GRPID>
 CONTACT, <GRPID>
```

Boundary Condition Type	Card
BOUNDARY	!BOUNDARY, !SPRING
LOAD	!CLOAD, !DLOAD, !TEMPERATURE

Boundary Condition Type	Card
CONTACT	!CONTACT

Output

```
!WRITE, VISUAL, FREQUENCY=<OutputInterval>
!WRITE, RESULT, FREQUENCY=<OutputInterval>
!OUTPUT_VIS
 <OutputVariableName>, <ON|OFF>
!OUTPUT_RES
 <OutputVariableName>, <ON|OFF>
!OUTPUT_SSTYPE, TYPE=<SOLUTION|MATERIAL>
```

VariableName	Physical Value	Target
DISP	Displacement	VIS,RES
REACTION	Nodal Reaction Force	VIS,RES
NSTRAIN	Nodal Strain	VIS,RES
NSTRESS	Nodal Stress	VIS,RES
NMISES	Nodal Mises Stress	VIS,RES
ESTRAIN	Elemental Strain	RES
ESTRESS	Elemental Stress	RES
EMISES	Elemental Mises Stress	RES
VEL	Velocity	VIS,RES
ACC	Acceleration	VIS,RES
TEMP	Temperature	VIS,RES

Restart

```
!RESTART, FREQUENCY=<n>
```

Local Coordinate

```
!ORIENTATION, NAME=<CoordinateSystem>,
DEFINITION=COORDINATES
<ax,ay,az>,<bx,by,bz>,<cx,cy,cz>
```

```
!ORIENTATION, NAME=<CoordinateSystem>,
DEFINITION=NODES
<a,b,c>
```

Section

```
!SECTION, SECNUM=<IndexOfSectionOfMeshData>,
ORIENTATION=<CoordinateSystem>, FORM361=
<FBAR|IC|BBAR|FI>
```

Material Property

```
!MATERIAL, NAME=<NameOfMaterial>
!ELASTIC, TYPE=<ISOTROPIC|ORTHOTROPIC>,
DEPENDENCIES=<0>
 <YoungsModulus>, <PoissonRatio>
!DENSITY
 <MassDensity>
!EXPANSION_COEFF, TYPE=
<ISOTROPIC|ORTHOTROPIC>, DEPENDENCIES=
<0>
 <LinearExpansion>
```

```
!PLASTIC, YIELD=MISES, HARDEN=BILINEAR,
DEPENDENCIES=<0>
 <InitialYieldStress>, <CuringCoefficient>
```

```
!PLASTIC, YIELD=MISES, HARDEN=MULTILINEAR,
DEPENDENCIES=<0>
 <YieldStress>, <PlasticStrain>
 <YieldStress>, <PlasticStrain>
 ...
```

```
!PLASTIC, YIELD=MISES, HARDEN=SWIFT,
DEPENDENCIES=<0>
 <ε0>, <K>, <n>
```

```
!PLASTIC, YIELD=<Mohr-Coulomb|Drucker-Prager>,
HARDEN=BILIENAR, DEPENDENCIES=<0>
 <Adhesive>, <InternalFrictionAngle>, <Curing>
```

```
!HYPERELASTIC, TYPE=NEOHOOKE
 <C10>, <D>
```

```
!VISCOELASTIC
 <ShearRelaxationModulus>, <RelaxationTime>
```

```
!CREEP, TYPE=Norton, DEPENDENCIES=<0>
 <A>, <n>, <m>
```

Solver Control

```
!SOLVER, METHOD=<CG>, PRECOND=<1>,
MPCMETHOD=<3>
 <MaxIteration>, <PreIteration>, <Krilov>,
<Color>, <ReuseSetup>
 <TruncationError>, <DiagonalScale>, 0.0
```

Method	Notes
CG	
BiCGSTAB	
GMRES	Enable Number Of Krilov Subspaces
GPBiCG	
DIRECT	
DIRECTmkl	Use for Contact Analysis
MUMPS	

Value	Precondition
1,2	SSOR
3	Diagonal Scaling
5	AMG
10	Block ILU(0)
11	Block ILU(1)
12	Block ILU(2)

Value	Method of MPC
1	Penalty
2	MPC-CG
3	Explicit Elimination

Solver Control （AMG）

```
!SOLVER, METHOD=<CG>, PRECOND=5,
MPCMETHOD=<3>
 <MaxIteration>, <PreIteration>, <Krilov>,
<Color>, <ReuseSetup>
 <TruncationError>, <DiagonalScale>, 0.0
 <CoarseSolver>, <Smoother>, <MultigridCycle>,
<MaxLevel>, <Scheme>, <Sweep>
```

Post Process （for ParaView）

```
!VISUAL
!output_type=VTK
```

Post Process （output BMP）

```
!VISUAL, method=PSR
!surface_num=1
!surface
!surface_style=1
!display_method=1
!color_comp_name=STRESS
!color_comp=7
!x_resolution=800
!y_resolution=600
!output_type=BMP
```

Nonlinear Analysis

Analysis Type	Related Cards
Static Analysis	!SOLUTION, TYPE=NLSTATIC !STEP
Dynamic Analysis	!DYNAMIC, TYPE=NONLINEAR !STEP
Contact Analysis	!CONTACT !CONTACT_ALGO !STEP
Material Nonlinear	!PLASTIC !HYPERELASTIC !VISCOELASTIC !CREEP