pyCGNS.PAT/Manual

Release 4.0.1

Marc Poinot

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CONTENTS

The module to create and manipulate SIDS/Python trees. PAT has a *cgnslib* module with functions to create SIDS/Python compliant data structures. PAT defines all the CGNS types, names, enumerates or any other CGNS keyword.

CHAPTER

ONE

SIDS PATTERNS

This module contains all the CGNS/SIDS structures using CGNS.PAT as API.

CHAPTER

TWO

THE PYTHONISH CGNS LIB

The so-called *CGNS lib* or *MLL* or *Mid-level* library, is set of functions for used to read/write/modify a set of nodes matching a CGNS/SIDS type. The Pythonish flavour of this library declares a set of functions with more or less the same interface but with Python values.

CHAPTER

THREE

CGNS KEYWORDS

Instead of generating a new doc from a file, the file itself is included here. The purpose of *cgnskeywords.py* is to declare all constants as Python variables. This leads to several advantages:

- You cannot make a typo on a name. For example, if you use "ZoneGridConnectivity" as a plain string you may mistype it as "Zonegridconnectivity" or "ZoneGridConectivity" and this may silently produce a bad CGNS tree.
- You can handle enumerate as lists. For example you have lists for units: MassUnits_l, LengthUnits_l, AllDimensionalUnits_l, AllUnits_l
- You can identify what is a CGNS reserved or recommended name or not.

```
#  -------------------------------------------------------------------------
#  pyCGNS.PAT - Python package for CFD General Notation System - PATternMaker
#  See license.txt file in the root directory of this Python module source
#  -------------------------------------------------------------------------
#  $Release: v4.0.1 $
#  -------------------------------------------------------------------------

# -------------------------------------------------------------------------
# TYPES, ENUMERATES, CONSTANTS, NAMES from CGNS/SIDS v2.5.3
#
# [1] A CGNS/SIDS string constant is postfixed with _s
# 'ZoneType' is ZoneType_s
#
# [2] A CGNS/SIDS string constant repersenting a type has _ts
# 'ZoneType_t' is ZoneType_ts
#
# [3] A list of possible values for a given type has _l
# ZoneType_l is [Structured_s,Unstructured_s,Null_s,UserDefined_s]
# which is same as ["Structured","Unstructured","Null","UserDefined"]
#
# [4] An enumerate mapping of a list of values is not prefixed
# ZoneType is {'Unstructured':3,'Null':0,'Structured':2,'UserDefined':1}
#
# [5] The reverse dictionnary of the previous one is postfixed with _
# ZoneType_ is {0:'Null',1:'UserDefined',2:'Structured',3:'Unstructured'}
#
# -------------------------------------------------------------------------
#
import CGNS.pyCGNSconfig

# ------------------------------------------------- MLL numeric constants
try:
  CGNS_VERSION = int(float(CGNS.pyCGNSconfig.MLL_VERSION))
  CGNS_DOTVERS = CGNS_VERSION/1000.
except TypeError:
  CGNS_VERSION = 2520
  CGNS_DOTVERS = 2.52
```

```
MODE_READ  = 0
MODE_WRITE = 1

if (CGNS_VERSION<3000):
  MODE_MODIFY = 3
  MODE_CLOSED = 2
else:
  MODE_MODIFY = 2
  MODE_CLOSED = 3

CG_OK              = 0
CG_ERROR           = 1
CG_NODE_NOT_FOUND  = 2
CG_INCORRECT_PATH  = 3
CG_NO_INDEX_DIM    = 4

Null               = 0
UserDefined        = 1

CG_FILE_NONE       = 0
CG_FILE_ADF        = 1
CG_FILE_HDF5       = 2
CG_FILE_XML        = 3

# ----------------------------------------------------
# --- ADF Datatypes
#
(C1,I4,I8,R4,R8,MT,LK)=('C1','I4','I8','R4','R8','MT','LK')

# ---------------------------------------------------- (NOT SIDS)
# --- CGNS/Python mapping extensions
#
CGNSTree_ts            = 'CGNSTree_t'
CGNSTree_s             = 'CGNSTree'

# --- Type with weird (coming from outer space) names
#
Transform_ts           = 'Transform_t"'
DiffusionModel_ts      = 'DiffusionModel_t'
EquationDimension_ts   = 'EquationDimension_t'
InwardNormalIndex_ts   = 'InwardNormalIndex_t'

# --- Add legacy strings for translation tools
#
Transform_ts2          = '"int[IndexDimension]"'
DiffusionModel_ts2     = '"int[1+...+IndexDimension]"'
EquationDimension_ts2  = '"int"'
InwardNormalIndex_ts2  = '"int[IndexDimension]"'

# ---------------------------------------------------- (SIDS)
# SIDS
#
Null_s = "Null"
UserDefined_s = "UserDefined"

# ----------------------------------------------------
Kilogram_s  = "Kilogram"
Gram_s      = "Gram"
Slug_s      = "Slug"
PoundMass_s = "PoundMass"
MassUnits_l = [Kilogram_s,Gram_s,Slug_s,PoundMass_s,
               Null_s,UserDefined_s]
```

```
# ----------------------------------------------------
Meter_s       = "Meter"
Centimeter_s  = "Centimeter"
Millimeter_s  = "Millimeter"
Foot_s        = "Foot"
Inch_s        = "Inch"
LengthUnits_l = [Meter_s,Centimeter_s,Millimeter_s,Foot_s,Inch_s,
                 Null_s,UserDefined_s]

# ----------------------------------------------------
Second_s    = "Second"
TimeUnits_l = [Second_s,Null_s,UserDefined_s]

# ----------------------------------------------------
Kelvin_s           = "Kelvin"
Celcius_s          = "Celcius"
Rankine_s          = "Rankine"
Fahrenheit_s       = "Fahrenheit"
TemperatureUnits_l = [Kelvin_s,Celcius_s,Rankine_s,Fahrenheit_s,
                      Null_s,UserDefined_s]

# ----------------------------------------------------
Degree_s     = "Degree"
Radian_s     = "Radian"
AngleUnits_l = [Degree_s,Radian_s,Null_s,UserDefined_s]

# ----------------------------------------------------
Ampere_s               = "Ampere"
Abampere_s             = "Abampere"
Statampere_s           = "Statampere"
Edison_s               = "Edison"
auCurrent_s            = "auCurrent"
ElectricCurrentUnits_l = [Ampere_s,Abampere_s,Statampere_s,Edison_s,auCurrent_s,
                          Null_s,UserDefined_s]

# ----------------------------------------------------
Mole_s                 = "Mole"
Entities_s             = "Entities"
StandardCubicFoot_s    = "StandardCubicFoot"
StandardCubicMeter_s   = "StandardCubicMeter"
SubstanceAmountUnits_l =[Mole_s,Entities_s,StandardCubicFoot_s,StandardCubicMeter_s,
                         Null_s,UserDefined_s]

# ----------------------------------------------------
Candela_s                = "Candela"
Candle_s                 = "Candle"
Carcel_s                 = "Carcel"
Hefner_s                 = "Hefner"
Violle_s                 = "Violle"
LuminousIntensityUnits_l = [Candela_s,Candle_s,Carcel_s,Hefner_s,Violle_s,
                            Null_s,UserDefined_s]

DimensionalUnits_s    = "DimensionalUnits"
AdditionalUnits_s     = "AdditionalUnits"
AdditionalExponents_s = "AdditionalExponents"

AllDimensionalUnits_l = TimeUnits_l+MassUnits_l+LengthUnits_l\
                        +TemperatureUnits_l+AngleUnits_l
AllAdditionalUnits_l  = LuminousIntensityUnits_l+SubstanceAmountUnits_l\
                        +ElectricCurrentUnits_l
AllUnits_l            = AllDimensionalUnits_l+AllAdditionalUnits_l
```

```
# ------------------------------------------------
Dimensional_s                    = "Dimensional"
NormalizedByDimensional_s        = "NormalizedByDimensional"
NormalizedByUnknownDimensional_s = "NormalizedByUnknownDimensional"
NondimensionalParameter_s        = "NondimensionalParameter"
DimensionlessConstant_s          = "DimensionlessConstant"
DataClass_l=[Dimensional_s,NormalizedByDimensional_s,
             NormalizedByUnknownDimensional_s,NondimensionalParameter_s,
             DimensionlessConstant_s,Null_s,UserDefined_s]

DataClass_ts = "DataClass_t"
DataClass_s  = "DataClass"

# ------------------------------------------------------------
Vertex_s       = "Vertex"
CellCenter_s   = "CellCenter"
FaceCenter_s   = "FaceCenter"
IFaceCenter_s  = "IFaceCenter"
JFaceCenter_s  = "JFaceCenter"
KFaceCenter_s  = "KFaceCenter"
EdgeCenter_s   = "EdgeCenter"

GridLocation_s = "GridLocation"

GridLocation_l = [CellCenter_s,Vertex_s,FaceCenter_s,
                  IFaceCenter_s,JFaceCenter_s,KFaceCenter_s,
                  EdgeCenter_s,Null_s,UserDefined_s]

# ------------------------------------------------------------
DirichletData_s = "DirichletData"
NeumannData_s   = "NeumannData"
Dirichlet_s     = "Dirichlet"
Neumann_s       = "Neumann"

PointList_s                  = "PointList"
PointListDonor_s             = "PointListDonor"
PointRange_s                 = "PointRange"
PointRangeDonor_s            = "PointRangeDonor"
ElementRange_s               = "ElementRange"
ElementList_s                = "ElementList"
CellListDonor_s              = "CellListDonor"

FullPotential_s              = "FullPotential"
Euler_s                      = "Euler"
NSLaminar_s                  = "NSLaminar"
NSTurbulent_s                = "NSTurbulent"
NSLaminarIncompressible_s    = "NSLaminarIncompressible"
NSTurbulentIncompressible_s  = "NSTurbulentIncompressible"

Ideal_s                      = "Ideal"
VanderWaals_s                = "VanderWaals"
Constant_s                   = "Constant"
PowerLaw_s                   = "PowerLaw"
SutherlandLaw_s              = "SutherlandLaw"
ConstantPrandtl_s            = "ConstantPrandtl"
EddyViscosity_s              = "EddyViscosity"
ReynoldsStress_s             = "ReynoldsStress"
Algebraic_s                  = "Algebraic"
BaldwinLomax_s               = "BaldwinLomax"
ReynoldsStressAlgebraic_s    = "ReynoldsStressAlgebraic"
Algebraic_BaldwinLomax_s     = "Algebraic_BaldwinLomax"
Algebraic_CebeciSmith_s      = "Algebraic_CebeciSmith"
HalfEquation_JohnsonKing_s   = "HalfEquation_JohnsonKing"
```

```
OneEquation_BaldwinBarth_s    = "OneEquation_BaldwinBarth"
OneEquation_SpalartAllmaras_s = "OneEquation_SpalartAllmaras"
TwoEquation_JonesLaunder_s    = "TwoEquation_JonesLaunder"
TwoEquation_MenterSST_s       = "TwoEquation_MenterSST"
TwoEquation_Wilcox_s          = "TwoEquation_Wilcox"
CaloricallyPerfect_s          = "CaloricallyPerfect"
ThermallyPerfect_s            = "ThermallyPerfect"
ConstantDensity_s             = "ConstantDensity"
RedlichKwong_s                = "RedlichKwong"
Frozen_s                      = "Frozen"
ThermalEquilib_s              = "ThermalEquilib"
ThermalNonequilib_s           = "ThermalNonequilib"
ChemicalEquilibCurveFit_s     = "ChemicalEquilibCurveFit"
ChemicalEquilibMinimization_s = "ChemicalEquilibMinimization"
ChemicalNonequilib_s          = "ChemicalNonequilib"
EMElectricField_s             = "EMElectricField"
EMMagneticField_s             = "EMMagneticField"
EMConductivity_s              = "EMConductivity"
Voltage_s                     = "Voltage"
Interpolated_s                = "Interpolated"
Equilibrium_LinRessler_s      = "Equilibrium_LinRessler"
Chemistry_LinRessler_s        = "Chemistry_LinRessler"

FamilySpecified_s             = "FamilySpecified"

Integer_s                     = "Integer"
RealSingle_s                  = "RealSingle"
RealDouble_s                  = "RealDouble"
Character_s                   = "Character"

NODE_s                        = "NODE"
BAR_2_s                       = "BAR_2"
BAR_3_s                       = "BAR_3"
TRI_3_s                       = "TRI_3"
TRI_6_s                       = "TRI_6"
QUAD_4_s                      = "QUAD_4"
QUAD_8_s                      = "QUAD_8"
QUAD_9_s                      = "QUAD_9"
TETRA_4_s                     = "TETRA_4"
TETRA_10_s                    = "TETRA_10"
PYRA_5_s                      = "PYRA_5"
PYRA_14_s                     = "PYRA_14"
PENTA_6_s                     = "PENTA_6"
PENTA_15_s                    = "PENTA_15"
PENTA_18_s                    = "PENTA_18"
HEXA_8_s                      = "HEXA_8"
HEXA_20_s                     = "HEXA_20"
HEXA_27_s                     = "HEXA_27"
MIXED_s                       = "MIXED"
NGON_n_s                      = "NGON_n"

# -------------------------------------------------
Overset_s       = "Overset"
Abutting_s      = "Abutting"
Abutting1to1_s  = "Abutting1to1"

GridConnectivityType_l = [Overset_s,Abutting_s,Abutting1to1_s,
                          Null_s,UserDefined_s]

# -------------------------------------------------
Structured_s   = "Structured"
Unstructured_s = "Unstructured"
ZoneType_s     = "ZoneType"
```

```
ZoneType_l     = [Structured_s,Unstructured_s,Null_s,UserDefined_s]

# ----------------------------------------------------
TimeAccurate_s    = "TimeAccurate"
NonTimeAccurate_s = "NonTimeAccurate"
SimulationType_ts = "SimulationType_t"
SimulationType_s  = "SimulationType"
SimulationType_l  = [TimeAccurate_s,NonTimeAccurate_s,Null_s,UserDefined_s]



# ----------------------------------------------------
ConstantRate_s        = "ConstantRate"
VariableRate_s        = "VariableRate"
NonDeformingGrid_s    = "NonDeformingGrid"
DeformingGrid_s       = "DeformingGrid"
RigidGridMotionType_l = [Null_s,ConstantRate_s,VariableRate_s,UserDefined_s]

RigidGridMotionType_s="RigidGridMotionType"
RigidGridMotionType_ts="RigidGridMotionType_t"

Generic_s                    = "Generic"
BleedArea_s                  = "BleedArea"
CaptureArea_s                = "CaptureArea"
AverageAll_s                 = "AverageAll"
AverageCircumferential_s     = "AverageCircumferential"
AverageRadial_s              = "AverageRadial"
AverageI_s                   = "AverageI"
AverageJ_s                   = "AverageJ"
AverageK_s                   = "AverageK"
CGNSLibraryVersion_s         = "CGNSLibraryVersion"
GridCoordinates_s            = "GridCoordinates"
ZoneGridConnectivity_s       = "ZoneGridConnectivity"
CoordinateNames_s            = "CoordinateNames"
CoordinateX_s                = "CoordinateX"
CoordinateY_s                = "CoordinateY"
CoordinateZ_s                = "CoordinateZ"
CoordinateR_s                = "CoordinateR"
CoordinateTheta_s            = "CoordinateTheta"
CoordinatePhi_s              = "CoordinatePhi"
CoordinateNormal_s           = "CoordinateNormal"
CoordinateTangential_s       = "CoordinateTangential"
CoordinateXi_s               = "CoordinateXi"
CoordinateEta_s              = "CoordinateEta"
CoordinateZeta_s             = "CoordinateZeta"
CoordinateTransform_s        = "CoordinateTransform"
InterpolantsDonor_s          = "InterpolantsDonor"
ElementConnectivity_s        = "ElementConnectivity"
ParentData_s                 = "ParentData"
VectorX_ps                   = "%sX"
VectorY_ps                   = "%sY"
VectorZ_ps                   = "%sZ"
VectorTheta_ps               = "%sTheta"
VectorPhi_ps                 = "%sPhi"
VectorMagnitude_ps           = "%sMagnitude"
VectorNormal_ps              = "%sNormal"
VectorTangential_ps          = "%sTangential"
Potential_s                  = "Potential"
StreamFunction_s             = "StreamFunction"
Density_s                    = "Density"
Pressure_s                   = "Pressure"
Temperature_s                = "Temperature"
EnergyInternal_s             = "EnergyInternal"
```

```
Enthalpy_s                    = "Enthalpy"
Entropy_s                     = "Entropy"
EntropyApprox_s               = "EntropyApprox"
DensityStagnation_s           = "DensityStagnation"
PressureStagnation_s          = "PressureStagnation"
TemperatureStagnation_s       = "TemperatureStagnation"
EnergyStagnation_s            = "EnergyStagnation"
EnthalpyStagnation_s          = "EnthalpyStagnation"
EnergyStagnationDensity_s     = "EnergyStagnationDensity"
VelocityX_s                   = "VelocityX"
VelocityY_s                   = "VelocityY"
VelocityZ_s                   = "VelocityZ"
VelocityR_s                   = "VelocityR"
VelocityTheta_s               = "VelocityTheta"
VelocityPhi_s                 = "VelocityPhi"
VelocityMagnitude_s           = "VelocityMagnitude"
VelocityNormal_s              = "VelocityNormal"
VelocityTangential_s          = "VelocityTangential"
VelocitySound_s               = "VelocitySound"
VelocitySoundStagnation_s     = "VelocitySoundStagnation"
MomentumX_s                   = "MomentumX"
MomentumY_s                   = "MomentumY"
MomentumZ_s                   = "MomentumZ"
MomentumMagnitude_s           = "MomentumMagnitude"
RotatingVelocityX_s           = "RotatingVelocityX"
RotatingVelocityY_s           = "RotatingVelocityY"
RotatingVelocityZ_s           = "RotatingVelocityZ"
RotatingMomentumX_s           = "RotatingMomentumX"
RotatingMomentumY_s           = "RotatingMomentumY"
RotatingMomentumZ_s           = "RotatingMomentumZ"
RotatingVelocityMagnitude_s   = "RotatingVelocityMagnitude"
RotatingPressureStagnation_s  = "RotatingPressureStagnation"
RotatingEnergyStagnation_s    = "RotatingEnergyStagnation"
RotatingEnergyStagnationDensity_s = "RotatingEnergyStagnationDensity"
RotatingEnthalpyStagnation_s  = "RotatingEnthalpyStagnation"
EnergyKinetic_s               = "EnergyKinetic"
PressureDynamic_s             = "PressureDynamic"
SoundIntensityDB_s            = "SoundIntensityDB"
SoundIntensity_s              = "SoundIntensity"
VorticityX_s                  = "VorticityX"
VorticityY_s                  = "VorticityY"
VorticityZ_s                  = "VorticityZ"
VorticityMagnitude_s          = "VorticityMagnitude"
SkinFrictionX_s               = "SkinFrictionX"
SkinFrictionY_s               = "SkinFrictionY"
SkinFrictionZ_s               = "SkinFrictionZ"
SkinFrictionMagnitude_s       = "SkinFrictionMagnitude"
VelocityAngleX_s              = "VelocityAngleX"
VelocityAngleY_s              = "VelocityAngleY"
VelocityAngleZ_s              = "VelocityAngleZ"
VelocityUnitVectorX_s         = "VelocityUnitVectorX"
VelocityUnitVectorY_s         = "VelocityUnitVectorY"
VelocityUnitVectorZ_s         = "VelocityUnitVectorZ"
MassFlow_s                    = "MassFlow"
ViscosityKinematic_s          = "ViscosityKinematic"
ViscosityMolecular_s          = "ViscosityMolecular"
ViscosityEddyDynamic_s        = "ViscosityEddyDynamic"
ViscosityEddy_s               = "ViscosityEddy"
ThermalConductivity_s         = "ThermalConductivity"
PowerLawExponent_s            = "PowerLawExponent"
SutherlandLawConstant_s       = "SutherlandLawConstant"
TemperatureReference_s        = "TemperatureReference"
ViscosityMolecularReference_s = "ViscosityMolecularReference"
```

```
ThermalConductivityReference_s = "ThermalConductivityReference"
IdealGasConstant_s             = "IdealGasConstant"
SpecificHeatPressure_s         = "SpecificHeatPressure"
SpecificHeatVolume_s           = "SpecificHeatVolume"
ReynoldsStressXX_s             = "ReynoldsStressXX"
ReynoldsStressXY_s             = "ReynoldsStressXY"
ReynoldsStressXZ_s             = "ReynoldsStressXZ"
ReynoldsStressYY_s             = "ReynoldsStressYY"
ReynoldsStressYZ_s             = "ReynoldsStressYZ"
ReynoldsStressZZ_s             = "ReynoldsStressZZ"
LengthReference_s              = "LengthReference"
MolecularWeight_s              = "MolecularWeight"
MolecularWeight_ps             = "MolecularWeight%s"
HeatOfFormation_s              = "HeatOfFormation"
HeatOfFormation_ps             = "HeatOfFormation%s"
FuelAirRatio_s                 = "FuelAirRatio"
ReferenceTemperatureHOF_s      = "ReferenceTemperatureHOF"
MassFraction_s                 = "MassFraction"
MassFraction_ps                = "MassFraction%s"
LaminarViscosity_s             = "LaminarViscosity"
LaminarViscosity_ps            = "LaminarViscosity%s"
ThermalConductivity_ps         = "ThermalConductivity%s"
EnthalpyEnergyRatio_s          = "EnthalpyEnergyRatio"
CompressibilityFactor_s        = "CompressibilityFactor"
VibrationalElectronEnergy_s    = "VibrationalElectronEnergy"
VibrationalElectronTemperature_s = "VibrationalElectronTemperature"
SpeciesDensity_s               = "SpeciesDensity"
SpeciesDensity_ps              = "SpeciesDensity%s"
MoleFraction_s                 = "MoleFraction"
MoleFraction_ps                = "MoleFraction%s"
ElectricFieldX_s               = "ElectricFieldX"
ElectricFieldY_s               = "ElectricFieldY"
ElectricFieldZ_s               = "ElectricFieldZ"
MagneticFieldX_s               = "MagneticFieldX"
MagneticFieldY_s               = "MagneticFieldY"
MagneticFieldZ_s               = "MagneticFieldZ"
CurrentDensityX_s              = "CurrentDensityX"
CurrentDensityY_s              = "CurrentDensityY"
CurrentDensityZ_s              = "CurrentDensityZ"
LorentzForceX_s                = "LorentzForceX"
LorentzForceY_s                = "LorentzForceY"
LorentzForceZ_s                = "LorentzForceZ"
ElectricConductivity_s         = "ElectricConductivity"
JouleHeating_s                 = "JouleHeating"
TurbulentDistance_s            = "TurbulentDistance"
TurbulentEnergyKinetic_s       = "TurbulentEnergyKinetic"
TurbulentDissipation_s         = "TurbulentDissipation"
TurbulentDissipationRate_s     = "TurbulentDissipationRate"
TurbulentBBReynolds_s          = "TurbulentBBReynolds"
TurbulentSANuTilde_s           = "TurbulentSANuTilde"
Mach_s                         = "Mach"
Mach_Velocity_s                = "Mach_Velocity"
Mach_VelocitySound_s           = "Mach_VelocitySound"
Reynolds_s                     = "Reynolds"
Reynolds_Velocity_s            = "Reynolds_Velocity"
Reynolds_Length_s              = "Reynolds_Length"
Reynolds_ViscosityKinematic_s  = "Reynolds_ViscosityKinematic"
Prandtl_s                      = "Prandtl"
Prandtl_ThermalConductivity_s  = "Prandtl_ThermalConductivity"
Prandtl_ViscosityMolecular_s   = "Prandtl_ViscosityMolecular"
Prandtl_SpecificHeatPressure_s = "Prandtl_SpecificHeatPressure"
PrandtlTurbulent_s             = "PrandtlTurbulent"
SpecificHeatRatio_s            = "SpecificHeatRatio"
```

```
SpecificHeatRatio_Pressure_s  = "SpecificHeatRatio_Pressure"
SpecificHeatRatio_Volume_s    = "SpecificHeatRatio_Volume"
CoefPressure_s                = "CoefPressure"
CoefSkinFrictionX_s           = "CoefSkinFrictionX"
CoefSkinFrictionY_s           = "CoefSkinFrictionY"
CoefSkinFrictionZ_s           = "CoefSkinFrictionZ"
Coef_PressureDynamic_s        = "Coef_PressureDynamic"
Coef_PressureReference_s      = "Coef_PressureReference"
Vorticity_s                   = "Vorticity"
Acoustic_s                    = "Acoustic"
RiemannInvariantPlus_s        = "RiemannInvariantPlus"
RiemannInvariantMinus_s       = "RiemannInvariantMinus"
CharacteristicEntropy_s       = "CharacteristicEntropy"
CharacteristicVorticity1_s    = "CharacteristicVorticity1"
CharacteristicVorticity2_s    = "CharacteristicVorticity2"
CharacteristicAcousticPlus_s  = "CharacteristicAcousticPlus"
CharacteristicAcousticMinus_s = "CharacteristicAcousticMinus"
ForceX_s                      = "ForceX"
ForceY_s                      = "ForceY"
ForceZ_s                      = "ForceZ"
ForceR_s                      = "ForceR"
ForceTheta_s                  = "ForceTheta"
ForcePhi_s                    = "ForcePhi"
Lift_s                        = "Lift"
Drag_s                        = "Drag"
MomentX_s                     = "MomentX"
MomentY_s                     = "MomentY"
MomentZ_s                     = "MomentZ"
MomentR_s                     = "MomentR"
MomentTheta_s                 = "MomentTheta"
MomentPhi_s                   = "MomentPhi"
MomentXi_s                    = "MomentXi"
MomentEta_s                   = "MomentEta"
MomentZeta_s                  = "MomentZeta"
Moment_CenterX_s              = "Moment_CenterX"
Moment_CenterY_s              = "Moment_CenterY"
Moment_CenterZ_s              = "Moment_CenterZ"
CoefLift_s                    = "CoefLift"
CoefDrag_s                    = "CoefDrag"
CoefMomentX_s                 = "CoefMomentX"
CoefMomentY_s                 = "CoefMomentY"
CoefMomentZ_s                 = "CoefMomentZ"
CoefMomentR_s                 = "CoefMomentR"
CoefMomentTheta_s             = "CoefMomentTheta"
CoefMomentPhi_s               = "CoefMomentPhi"
CoefMomentXi_s                = "CoefMomentXi"
CoefMomentEta_s               = "CoefMomentEta"
CoefMomentZeta_s              = "CoefMomentZeta"
Coef_PressureDynamic_s        = "Coef_PressureDynamic"
Coef_Area_s                   = "Coef_Area"
Coef_Length_s                 = "Coef_Length"
TimeValues_s                  = "TimeValues"
IterationValues_s             = "IterationValues"
NumberOfZones_s               = "NumberOfZones"
NumberOfFamilies_s            = "NumberOfFamilies"
DataConversion_s              ="DataConversion"

ZonePointers_s                = "ZonePointers"
FamilyPointers_s              = "FamilyPointers"
RigidGridMotionPointers_s     = "RigidGridMotionPointers"
ArbitraryGridMotionPointers_s = "ArbitraryGridMotionPointers"
GridCoordinatesPointers_s     = "GridCoordinatesPointers"
FlowSolutionsPointers_s       = "FlowSolutionsPointers"
```

```
PointerNames_l = [ZonePointers_s,FamilyPointers_s,RigidGridMotionPointers_s,
                  ArbitraryGridMotionPointers_s,GridCoordinatesPointers_s,
                  FlowSolutionsPointers_s]

OriginLocation_s              = "OriginLocation"
RigidRotationAngle_s          = "RigidRotationAngle"
Translation_s                 = "Translation"
RotationAngle_s               = "RotationAngle"
RigidVelocity_s               = "RigidVelocity"
RigidRotationRate_s           = "RigidRotationRate"
GridVelocityX_s               = "GridVelocityX"
GridVelocityY_s               = "GridVelocityY"
GridVelocityZ_s               = "GridVelocityZ"
GridVelocityR_s               = "GridVelocityR"
GridVelocityTheta_s           = "GridVelocityTheta"
GridVelocityPhi_s             = "GridVelocityPhi"
GridVelocityXi_s              = "GridVelocityXi"
GridVelocityEta_s             = "GridVelocityEta"
GridVelocityZeta_s            = "GridVelocityZeta"

ArbitraryGridMotion_ts        = "ArbitraryGridMotion_t"
ArbitraryGridMotion_s         = "ArbitraryGridMotion"
ArbitraryGridMotionType_l     = [Null_s,NonDeformingGrid_s,
                                 DeformingGrid_s,UserDefined_s]

ArbitraryGridMotionType_s     ="ArbitraryGridMotionType"
ArbitraryGridMotionType_ts    ="ArbitraryGridMotionType_t"

Area_ts                       = "Area_t"
Area_s                        = "Area"
AreaType_ts                   = "AreaType_t"
AreaType_s                    = "AreaType"
SurfaceArea_s                 = "SurfaceArea"
RegionName_s                  = "RegionName"
AverageInterface_ts           = "AverageInterface_t"
Axisymmetry_ts                = "Axisymmetry_t"
Axisymmetry_s                 = "Axisymmetry"
AxisymmetryReferencePoint_s   = "AxisymmetryReferencePoint"
AxisymmetryAxisVector_s       = "AxisymmetryAxisVector"
AxisymmetryAngle_s            = "AxisymmetryAngle"
BCDataSet_ts                  = "BCDataSet_t"
BCData_ts                     = "BCData_t"
BCData_s                      = "BCData"

BCProperty_ts                 = "BCProperty_t"
BCProperty_s                  = "BCProperty"
BC_ts                         = "BC_t"

BaseIterativeData_ts          = "BaseIterativeData_t"
BaseIterativeData_s           = "BaseIterativeData"

CGNSBase_ts                   = "CGNSBase_t"
CGNSLibraryVersion_ts         = "CGNSLibraryVersion_t"


# ----------------------------------------------
ConvergenceHistory_ts         = "ConvergenceHistory_t"
ZoneConvergenceHistory_s      = "ZoneConvergenceHistory"
GlobalConvergenceHistory_s    = "GlobalConvergenceHistory"

ConvergenceHistory_l          = [ZoneConvergenceHistory_s,
                                 GlobalConvergenceHistory_s]
```

```
NormDefinitions_s             ="NormDefinitions"

DataArray_ts                  = "DataArray_t"
DataConversion_ts             = "DataConversion_t"
Descriptor_ts                 = "Descriptor_t"

# ------------------------------------------------
DimensionalExponents_ts       = "DimensionalExponents_t"
DimensionalExponents_s        = "DimensionalExponents"
DimensionalUnits_ts           = "DimensionalUnits_t"
AdditionalUnits_ts            = "AdditionalUnits_t"
AdditionalExponents_ts        = "AdditionalExponents_t"

DiscreteData_ts               = "DiscreteData_t"
DiscreteData_s                = "DiscreteData"
Elements_ts                   = "Elements_t"

FamilyBC_s                    = "FamilyBC"
FamilyBC_ts                   = "FamilyBC_t"

FamilyName_ts                 = "FamilyName_t"
FamilyName_s                  = "FamilyName"
Family_ts                     = "Family_t"
Family_s                      = "Family"
FlowEquationSet_ts            = "FlowEquationSet_t"
FlowEquationSet_s             = "FlowEquationSet"
FlowSolution_ts               = "FlowSolution_t"
GasModel_ts                   = "GasModel_t"
GasModel_s                    = "GasModel"
#
GeometryEntity_ts             = "GeometryEntity_t"
GeometryFile_ts               = "GeometryFile_t"
GeometryFile_s                = "GeometryFile"

#chapter 12.7
GeometryFormat_s              = "GeometryFormat"
GeometryFormat_ts             = "GeometryFormat_t"
# not supported '-'
NASAIGES_s                    ="NASA-IGES"
SDRC_s                        ="SDRC"
Unigraphics_s                 ="Unigraphics"
ProEngineer_s                 ="ProEngineer"
ICEMCFD_s                     ="ICEM-CFD"
GeometryFormat_l              =[Null_s,NASAIGES_s,SDRC_s,Unigraphics_s,
                                ProEngineer_s,ICEMCFD_s,UserDefined_s]
GeometryReference_ts          = "GeometryReference_t"
GeometryReference_s           = "GeometryReference"


Gravity_ts                    = "Gravity_t"
Gravity_s                     = "Gravity"
GravityVector_s               = "GravityVector"

GridConnectivity1to1_ts       = "GridConnectivity1to1_t"
GridConnectivityProperty_ts   = "GridConnectivityProperty_t"
GridConnectivityProperty_s    = "GridConnectivityProperty"
GridConnectivityType_ts       = "GridConnectivityType_t"
GridConnectivityType_s        = "GridConnectivityType"
GridConnectivity_ts           = "GridConnectivity_t"

GridCoordinates_ts            = "GridCoordinates_t"
GridLocation_ts               = "GridLocation_t"
IndexArray_ts                 = "IndexArray_t"
```

```
IndexRange_ts                 = "IndexRange_t"
IntegralData_ts               = "IntegralData_t"
InwardNormalList_ts           = "InwardNormalList_t"
InwardNormalList_s            = "InwardNormalList"
InwardNormalIndex_s           = "InwardNormalIndex"
Ordinal_ts                    = "Ordinal_t"
Ordinal_s                     = "Ordinal"
Transform_s                   = "Transform"
OversetHoles_ts               = "OversetHoles_t"
OversetHoles_s                = "OversetHoles"
Periodic_ts                   = "Periodic_t"
Periodic_s                    = "Periodic"

ReferenceState_ts             = "ReferenceState_t"
ReferenceState_s              = "ReferenceState"
ReferenceStateDescription_s   = "ReferenceStateDescription"

RigidGridMotion_ts            = "RigidGridMotion_t"
RigidGridMotion_s             = "RigidGridMotion"

Rind_s                        = "Rind"
Rind_ts                       = "Rind_t"

RotatingCoordinates_s         = "RotatingCoordinates"
RotatingCoordinates_ts        = "RotatingCoordinates_t"
RotationRateVector_s          = "RotationRateVector"
RotationCenter_s              = "RotationCenter"

GoverningEquations_s          = "GoverningEquations"
GoverningEquations_ts         = "GoverningEquations_t"
GoverningEquationsType_l      = [Euler_s,NSLaminar_s,NSTurbulent_s]
GoverningEquationsType_s      = "GoverningEquationsType"
GoverningEquationsType_ts     = "GoverningEquationsType_t"

BCType_s                      = "BCType"
BCType_ts                     = "BCType_t"
BCTypeSimple_s                = "BCTypeSimple"
BCTypeSimple_ts               = "BCTypeSimple_t"

BCAxisymmetricWedge_s         = "BCAxisymmetricWedge"
BCDegenerateLine_s            = "BCDegenerateLine"
BCDegeneratePoint_s           = "BCDegeneratePoint"
BCDirichlet_s                 = "BCDirichlet"
BCExtrapolate_s               = "BCExtrapolate"
BCFarfield_s                  = "BCFarfield"
BCGeneral_s                   = "BCGeneral"
BCInflow_s                    = "BCInflow"
BCInflowSubsonic_s            = "BCInflowSubsonic"
BCInflowSupersonic_s          = "BCInflowSupersonic"
BCNeumann_s                   = "BCNeumann"
BCOutflow_s                   = "BCOutflow"
BCOutflowSubsonic_s           = "BCOutflowSubsonic"
BCOutflowSupersonic_s         = "BCOutflowSupersonic"
BCSymmetryPlane_s             = "BCSymmetryPlane"
BCSymmetryPolar_s             = "BCSymmetryPolar"
BCTunnelInflow_s              = "BCTunnelInflow"
BCTunnelOutflow_s             = "BCTunnelOutflow"
BCWall_s                      = "BCWall"
BCWallInviscid_s              = "BCWallInviscid"
BCWallViscous_s               = "BCWallViscous"
BCWallViscousHeatFlux_s       = "BCWallViscousHeatFlux"
BCWallViscousIsothermal_s     = "BCWallViscousIsothermal"
BCTypeSimple_l    =[Null_s,BCGeneral_s,BCDirichlet_s,BCNeumann_s,
```

```
                    BCExtrapolate_s,BCWallInviscid_s,BCWallViscousHeatFlux_s,
                    BCWallViscousIsothermal_s,BCWallViscous_s,BCWall_s,
                    BCInflowSubsonic_s,BCInflowSupersonic_s,BCOutflowSubsonic_s,
                    BCOutflowSupersonic_s,BCTunnelInflow_s,BCTunnelOutflow_s,
                    BCDegenerateLine_s,BCDegeneratePoint_s,BCSymmetryPlane_s,
                    BCSymmetryPolar_s,BCAxisymmetricWedge_s,FamilySpecified_s,
                    UserDefined_s]
BCTypeCompound_l = [BCInflow_s,BCOutflow_s,BCFarfield_s,
                     Null_s,UserDefined_s]
BCType_l         = BCTypeSimple_l+BCTypeCompound_l

ThermalConductivityModel_ts          = "ThermalConductivityModel_t"
ThermalConductivityModel_s           = "ThermalConductivityModel"
ThermalConductivityModelType_l       = [Null_s,ConstantPrandtl_s,PowerLaw_s,
                                        SutherlandLaw_s,UserDefined_s]
ThermalConductivityModelType_s       = "ThermalConductivityModelType"
ThermalConductivityModelType_ts      = "ThermalConductivityModelType_t"
ThermalConductivityModelIdentifier_l = [(Prandtl_s),(PowerLawExponent_s),
                                        (SutherlandLawConstant_s),
                                        (TemperatureReference_s),
                                        (ThermalConductivityReference_s)]

TurbulenceClosure_ts          = "TurbulenceClosure_t"
TurbulenceClosure_s           = "TurbulenceClosure"
TurbulenceClosureType_l       = [Null_s,EddyViscosity_s,ReynoldsStress_s,
                                 ReynoldsStressAlgebraic_s,UserDefined_s]
TurbulenceClosureType_s       = "TurbulenceClosureType"
TurbulenceClosureType_ts      = "TurbulenceClosureType_t"
TurbulenceClosureIdentifier_l = [PrandtlTurbulent_s]

TurbulenceModel_ts     = "TurbulenceModel_t"
TurbulenceModel_s      = "TurbulenceModel"
TurbulenceModelType_l  = [Null_s,Algebraic_BaldwinLomax_s,
                          Algebraic_CebeciSmith_s,
                          HalfEquation_JohnsonKing_s,
                          OneEquation_BaldwinBarth_s,
                          OneEquation_SpalartAllmaras_s,
                          TwoEquation_JonesLaunder_s,
                          TwoEquation_MenterSST_s,TwoEquation_Wilcox_s]
TurbulenceModelType_s  = "TurbulenceModelType"
TurbulenceModelType_ts = "TurbulenceModelType_t"

DiffusionModel_s    = 'DiffusionModel'
EquationDimension_s = 'EquationDimension'

ViscosityModel_ts          = "ViscosityModel_t"
ViscosityModel_s           = "ViscosityModel"
ViscosityModelType_l       = [Constant_s,PowerLaw_s,SutherlandLaw_s,
                              Null_s,UserDefined_s]
ViscosityModelType_s       = "ViscosityModelType"
ViscosityModelType_ts      = "ViscosityModelType_t"
ViscosityModelIdentifier_l = [(PowerLawExponent_s),(SutherlandLawConstant_s),
                              (TemperatureReference_s),
                              (ViscosityMolecularReference_s)]

GasModelType_l       = [Null_s,Ideal_s,VanderWaals_s,CaloricallyPerfect_s,
                        ThermallyPerfect_s,ConstantDensity_s,RedlichKwong_s,
                        UserDefined_s]
GasModelType_s       = "GasModelType"
GasModelType_ts      = "GasModelType_t"
GasModelIdentifier_l = [IdealGasConstant_s,SpecificHeatRatio_s,
                        SpecificHeatVolume_s,SpecificHeatPressure_s]
```

```
ThermalRelaxationModel_ts     = "ThermalRelaxationModel_t"
ThermalRelaxationModel_s      = "ThermalRelaxationModel"
ThermalRelaxationModelType_l  = [Null_s,Frozen_s,ThermalEquilib_s,
                                 ThermalNonequilib_s,UserDefined_s]
ThermalRelaxationModelType_s  = "ThermalRelaxationModelType"
ThermalRelaxationModelType_ts = "ThermalRelaxationModelType_t"

ChemicalKineticsModel_ts          = "ChemicalKineticsModel_t"
ChemicalKineticsModel_s           = "ChemicalKineticsModel"
ChemicalKineticsModelType_l       = [Null_s,Frozen_s,ChemicalEquilibCurveFit_s,
                                     ChemicalEquilibMinimization_s,
                                     ChemicalNonequilib_s,
                                     UserDefined_s]
ChemicalKineticsModelType_s       = "ChemicalKineticsModelType"
ChemicalKineticsModelType_ts      = "ChemicalKineticsModelType_t"
ChemicalKineticsModelIdentifier_l = [FuelAirRatio_s,ReferenceTemperatureHOF_s]

EMElectricFieldModel_s      = "EMElectricFieldModel"
EMElectricFieldModel_ts     = "EMElectricFieldModel_t"
EMElectricFieldModelType_l  = [Null_s,Constant_s,Frozen_s,
                               Interpolated_s,Voltage_s,UserDefined_s]
EMElectricFieldModelType_s  = "EMElectricFieldModelType"
EMElectricFieldModelType_ts = "EMElectricFieldModelType_t"

EMMagneticFieldModel_s      = "EMMagneticFieldModel"
EMMagneticFieldModel_ts     = "EMMagneticFieldModel_t"
EMMagneticFieldModelType_l  = [Null_s,Constant_s,Frozen_s,
                               Interpolated_s,UserDefined_s]
EMMagneticFieldModelType_s  = "EMMagneticFieldModelType"
EMMagneticFieldModelType_ts = "EMMagneticFieldModelType_t"

EMConductivityModel_s           = "EMConductivityModel"
EMConductivityModel_ts          = "EMConductivityModel_t"
EMConductivityModelType_l       = [Null_s,Constant_s,Frozen_s,
                                   Equilibrium_LinRessler_s,
                                   Chemistry_LinRessler_s,UserDefined_s]
EMConductivityModelType_s       = "EMConductivityModelType"
EMConductivityModelType_ts      = "EMConductivityModelType_t"
EMConductivityModelIdentifier_l = [ElectricFieldX_s,ElectricFieldY_s,
                                   ElectricFieldZ_s,MagneticFieldX_s,
                                   MagneticFieldY_s,MagneticFieldZ_s,
                                   CurrentDensityX_s,CurrentDensityY_s,
                                   CurrentDensityZ_s,ElectricConductivity_s,
                                   LorentzForceX_s,LorentzForceY_s,
                                   LorentzForceZ_s,JouleHeating_s]

AverageInterfaceType_s  = "AverageInterfaceType"
AverageInterfaceType_ts = "AverageInterfaceType_t"
AverageInterfaceType_l  = [Null_s,AverageAll_s,AverageCircumferential_s,
                           AverageRadial_s,AverageI_s,AverageJ_s,AverageK_s,
                           UserDefined_s]
AverageInterface_s      = "AverageInterface"
AverageInterface_ts     = "AverageInterface_t"

Element_ts     = "Element_t"
ElementType_ts = "ElementType_t"
ElementType_s  = "ElementType"
Element_s      = "Element"
ElementType_l  = [Null_s, NODE_s, BAR_2_s, BAR_3_s,
                  TRI_3_s, TRI_6_s, QUAD_4_s, QUAD_8_s, QUAD_9_s,
                  TETRA_4_s, TETRA_10_s, PYRA_5_s, PYRA_14_s,
                  PENTA_6_s, PENTA_15_s, PENTA_18_s,
                  HEXA_8_s, HEXA_20_s, HEXA_27_s, MIXED_s, NGON_n_s,
```

```
                  UserDefined_s]

#

WallFunction_ts               = "WallFunction_t"
WallFunction_s                = "WallFunction"
WallFunctionType_ts           = "WallFunctionType_t"
WallFunctionType_s            = "WallFunctionType"
ZoneBC_ts                     = "ZoneBC_t"
ZoneBC_s                      = "ZoneBC"
ZoneGridConnectivity_ts       = "ZoneGridConnectivity_t"
ZoneIterativeData_ts          = "ZoneIterativeData_t"
ZoneIterativeData_s           = "ZoneIterativeData"
ZoneType_ts                   = "ZoneType_t"
Zone_ts                       = "Zone_t"

UserDefinedData_ts            = "UserDefinedData_t"

# ---
cgnsnames=[k for k in dir() if (k[-2:]=='_s')]
cgnstypes=[k for k in dir() if (k[-3:]=='_ts')]
cgnsenums=[k for k in dir() if (k[-2:]=='_l')]
#
# --- last line
```

CHAPTER

FOUR

CGNS TYPES

4.1 AdditionalExponents_t

- Name
  - AdditionalExponents
- Data-Type: R4 R8
- Dimensions/DimensionValues
- Cardinality: Zero/One

4.2 AdditionalUnits_t

- Name
  - AdditionalUnits
- Data-Type: C1
- Dimensions/DimensionValues
- Cardinality: Zero/One

4.3 ArbitraryGridMotion_t

- Name
  - {UserDefined}
- Data-Type: C1
- Dimensions/DimensionValues
- Cardinality: Zero/N
- Child Nodes
  - *DataClass_t* (DataClass)
  - *DimensionalUnits_t* (DimensionalUnits)
  - *Descriptor_t* ({UserDefined})

  - *UserDefinedData_t* ({UserDefined})
  - *GridLocation_t* (GridLocation)
  - *Rind_t* (Rind)
  - *DataArray_t* ({UserDefined})

4.4 AreaType_t

- Name
  - AreaType
- Data-Type: C1
- Dimensions/DimensionValues
- Cardinality: One/One

4.5 Area_t

- Name
  - Area
- Data-Type: M T
- Dimensions/DimensionValues
- Cardinality: Zero/One
- Child Nodes
  - *Descriptor_t* ({UserDefined})
  - *UserDefinedData_t* ({UserDefined})
  - *AreaType_t* (AreaType)
  - *DataArray_t* (SurfaceArea)
  - *DataArray_t* (RegionName)

4.6 AverageInterfaceType_t

- Name
  - AverageInterfaceType
- Data-Type: C1
- Dimensions/DimensionValues
- Cardinality: One/One

4.7 AverageInterface_t

- Name
  - AverageInterface
- Data-Type: M T
- Dimensions/DimensionValues
- Cardinality: Zero/One
- Child Nodes
  - *Descriptor_t* ({UserDefined})
  - *UserDefinedData_t* ({UserDefined})
  - *AverageInterfaceType_t* (AverageInterfaceType)

4.8 Axisymmetry_t

- Name
  - Axisymmetry
- Data-Type: M T
- Dimensions/DimensionValues
- Cardinality: Zero/One
- Child Nodes
  - *DataArray_t* (AxisymmetryReferencePoint)
  - *DataArray_t* (AxisymmetryAxisVector)
  - *DataArray_t* (AxisymmetryAngle)
  - *DataArray_t* (CoordinateNames)
  - *DataClass_t* (DataClass)
  - *DimensionalUnits_t* (DimensionalUnits)
  - *Descriptor_t* ({UserDefined})
  - *UserDefinedData_t* ({UserDefined})

4.9 BCDataSet_t

- Name
  - {UserDefined}
- Data-Type: C1
- Dimensions/DimensionValues
- Cardinality: Zero/N
- Child Nodes
  - *BCData_t* (NeumannData)

  - *BCData_t* (DirichletData)
  - *GridLocation_t* (GridLocation)
  - *IndexRange_t* (PointRange)
  - *IndexArray_t* (PointList)
  - *Descriptor_t* ({UserDefined})
  - *ReferenceState_t* (ReferenceState)
  - *DataClass_t* (DataClass)
  - *DimensionalUnits_t* (DimensionalUnits)
  - *UserDefinedData_t* ({UserDefined})

4.10 BCData_t

- Name
  - DirichletData
  - NeumannData
- Data-Type: M T
- Dimensions/DimensionValues
- Cardinality: Zero/One
- Child Nodes
  - *DataArray_t* ({UserDefined})
  - *DataClass_t* (DataClass)
  - *DimensionalUnits_t* (DimensionalUnits)
  - *Descriptor_t* ({UserDefined})
  - *UserDefinedData_t* ({UserDefined})

4.11 BCProperty_t

- Name
  - BCProperty
- Data-Type: M T
- Dimensions/DimensionValues
- Cardinality: Zero/One
- Child Nodes
  - *Descriptor_t* ({UserDefined})
  - *UserDefinedData_t* ({UserDefined})
  - *WallFunction_t* (WallFunction)
  - *Area_t* (Area)

4.12 BC_t

- Name
  - {UserDefined}
- Data-Type: C1
- Dimensions/DimensionValues
- Cardinality: Zero/N
- Child Nodes
  - *ReferenceState_t* (ReferenceState)
  - *DataClass_t* (DataClass)
  - *DimensionalUnits_t* (DimensionalUnits)
  - *Descriptor_t* ({UserDefined})
  - *UserDefinedData_t* ({UserDefined})
  - *Ordinal_t* (Ordinal)
  - *FamilyName_t* (FamilyName)
  - *IndexArray_t* (InwardNormalList)
  - *BCDataSet_t* ({UserDefined})
  - *InwardNormalIndex_t* (InwardNormalIndex)
  - *IndexArray_t* (ElementList)
  - *IndexArray_t* (PointList)
  - *IndexRange_t* (ElementRange)
  - *IndexRange_t* (PointRange)
  - *GridLocation_t* (GridLocation)
  - *BCProperty_t* (BCProperty)

4.13 BaseIterativeData_t

- Name
  - {UserDefined}
- Data-Type: I4
- Dimensions/DimensionValues
- Cardinality: Zero/One
- Child Nodes
  - *DataClass_t* (DataClass)
  - *DimensionalUnits_t* (DimensionalUnits)
  - *Descriptor_t* ({UserDefined})
  - *UserDefinedData_t* ({UserDefined})
  - *DataArray_t* ({UserDefined})

4.14 CGNSBase_t

- Name
  - {UserDefined}
- Data-Type: I4
- Dimensions/DimensionValues
- Cardinality: Zero/N
- Child Nodes
  - *Zone_t* ({UserDefined})
  - *SimulationType_t* (SimulationType)
  - *BaseIterativeData_t* ({UserDefined})
  - *IntegralData_t* ({UserDefined})
  - *ConvergenceHistory_t* (GlobalConvergenceHistory)
  - *Family_t* ({UserDefined})
  - *FlowEquationSet_t* (FlowEquationSet)
  - *ReferenceState_t* (ReferenceState)
  - *Axisymmetry_t* (Axisymmetry)
  - *RotatingCoordinates_t* (RotatingCoordinates)
  - *Gravity_t* (Gravity)
  - *DataClass_t* (DataClass)
  - *DimensionalUnits_t* (DimensionalUnits)
  - *Descriptor_t* ({UserDefined})
  - *UserDefinedData_t* ({UserDefined})

4.15 CGNSLibraryVersion_t

- Name
  - CGNSLibraryVersion
- Data-Type: R4
- Dimensions/DimensionValues
- Cardinality: One/One

4.16 CGNSTree_t

- Name
  - CGNSTree
  - {UserDefined}
- Data-Type: M T

- Dimensions/DimensionValues
- Cardinality: One/One
- Child Nodes
  - *CGNSLibraryVersion_t* (CGNSLibraryVersion)
  - *CGNSBase_t* ({UserDefined})

4.17 ChemicalKineticsModel_t

- Name
  - ChemicalKineticsModel
- Data-Type: C1
- Dimensions/DimensionValues
- Cardinality: Zero/One
- Child Nodes
  - *Descriptor_t* ({UserDefined})
  - *DataClass_t* (DataClass)
  - *DimensionalUnits_t* (DimensionalUnits)
  - *DataArray_t* ({UserDefined})
  - *UserDefinedData_t* ({UserDefined})

4.18 ConvergenceHistory_t

- Name
  - GlobalConvergenceHistory
  - ZoneConvergenceHistory
- Data-Type: I4
- Dimensions/DimensionValues
- Cardinality: Zero/One
- Child Nodes
  - *Descriptor_t* ({UserDefined})
  - *Descriptor_t* (NormDefinitions)
  - *DataClass_t* (DataClass)
  - *DimensionalUnits_t* (DimensionalUnits)
  - *DataArray_t* ({UserDefined})
  - *UserDefinedData_t* ({UserDefined})

4.19 DataArray_t

- Name
  - {UserDefined}
- Data-Type: C1 MT I4 I8 R4 R8 LK
- Dimensions/DimensionValues
- Cardinality: Zero/N
- Child Nodes
  - *DimensionalExponents_t* (DimensionalExponents)
  - *DataConversion_t* (DataConversion)
  - *DataClass_t* (DataClass)
  - *Descriptor_t* ({UserDefined})
  - *DimensionalUnits_t* (DimensionalUnits)

4.20 DataClass_t

- Name
  - DataClass
- Data-Type: C1
- Dimensions/DimensionValues
- Cardinality: Zero/One

4.21 DataConversion_t

- Name
  - DataConversion
- Data-Type: R4 R8
- Dimensions/DimensionValues
- Cardinality: Zero/One

4.22 Descriptor_t

- Name
  - {UserDefined}
- Data-Type: C1
- Dimensions/DimensionValues
- Cardinality: Zero/N

4.23 DiffusionModel_t

- Name
  - DiffusionModel
- Data-Type: I4
- Dimensions/DimensionValues
- Cardinality: Zero/One

4.24 DimensionalExponents_t

- Name
  - DimensionalExponents
- Data-Type: R4 R8
- Dimensions/DimensionValues
- Cardinality: Zero/One

4.25 DimensionalUnits_t

- Name
  - DimensionalUnits
- Data-Type: C1
- Dimensions/DimensionValues
- Cardinality: Zero/One
- Child Nodes
  - *AdditionalUnits_t* (AdditionalUnits)

4.26 DiscreteData_t

- Name
  - {UserDefined}
- Data-Type: M T
- Dimensions/DimensionValues
- Cardinality: Zero/N
- Child Nodes
  - *GridLocation_t* (GridLocation)
  - *DataArray_t* ({UserDefined})
  - *Rind_t* (Rind)

  - *DataClass_t* (DataClass)
  - *DimensionalUnits_t* (DimensionalUnits)
  - *Descriptor_t* ({UserDefined})
  - *UserDefinedData_t* ({UserDefined})

4.27 EMConductivityModel_t

- Name
  - EMConductivityModel
- Data-Type: C1
- Dimensions/DimensionValues
- Cardinality: Zero/One
- Child Nodes
  - *Descriptor_t* ({UserDefined})
  - *DataClass_t* (DataClass)
  - *DimensionalUnits_t* (DimensionalUnits)
  - *DataArray_t* ({UserDefined})
  - *UserDefinedData_t* ({UserDefined})

4.28 EMElectricFieldModel_t

- Name
  - EMElectricFieldModel
- Data-Type: C1
- Dimensions/DimensionValues
- Cardinality: Zero/One
- Child Nodes
  - *Descriptor_t* ({UserDefined})
  - *DataClass_t* (DataClass)
  - *DimensionalUnits_t* (DimensionalUnits)
  - *DataArray_t* ({UserDefined})
  - *UserDefinedData_t* ({UserDefined})

4.29 EMMagneticFieldModel_t

- Name
  - EMMagneticFieldModel
- Data-Type: C1
- Dimensions/DimensionValues
- Cardinality: Zero/One
- Child Nodes
  - *Descriptor_t* ({UserDefined})
  - *DataClass_t* (DataClass)
  - *DimensionalUnits_t* (DimensionalUnits)
  - *DataArray_t* ({UserDefined})
  - *UserDefinedData_t* ({UserDefined})

4.30 Elements_t

- Name
  - {UserDefined}
- Data-Type: I4
- Dimensions/DimensionValues
- Cardinality: Zero/N
- Child Nodes
  - *IndexRange_t* (ElementRange)
  - *DataArray_t* (ElementConnectivity)
  - *DataArray_t* (ParentData)
  - *Rind_t* (Rind)
  - *Descriptor_t* ({UserDefined})
  - *UserDefinedData_t* ({UserDefined})

4.31 EquationDimension_t

- Name
  - EquationDimension
- Data-Type: I4
- Dimensions/DimensionValues
- Cardinality: Zero/One

4.32 FamilyBC_t

- Name
  - FamilyBC
- Data-Type: C1
- Dimensions/DimensionValues
- Cardinality: Zero/One
- Child Nodes
  - *BCDataSet_t* ({UserDefined})

4.33 FamilyName_t

- Name
  - FamilyName
- Data-Type: C1
- Dimensions/DimensionValues
- Cardinality: Zero/One

4.34 Family_t

- Name
  - {UserDefined}
- Data-Type: M T
- Dimensions/DimensionValues
- Cardinality: Zero/N
- Child Nodes
  - *Descriptor_t* ({UserDefined})
  - *Ordinal_t* (Ordinal)
  - *FamilyBC_t* ({UserDefined})
  - *GeometryReference_t* ({UserDefined})
  - *RotatingCoordinates_t* (RotatingCoordinates)
  - *UserDefinedData_t* ({UserDefined})

4.35 FlowEquationSet_t

- Name
  - FlowEquationSet
- Data-Type: M T
- Dimensions/DimensionValues
- Cardinality: Zero/One
- Child Nodes
  - *GoverningEquations_t* (GoverningEquations)
  - *EquationDimension_t* (EquationDimension)
  - *GasModel_t* (GasModel)
  - *ViscosityModel_t* (ViscosityModel)
  - *ThermalRelaxationModel_t* (ThermalRelaxationModel)
  - *ThermalConductivityModel_t* (ThermalConductivityModel)
  - *TurbulenceModel_t* (TurbulenceModel)
  - *TurbulenceClosure_t* (TurbulenceClosure)
  - *ChemicalKineticsModel_t* (ChemicalKineticsModel)
  - *EMMagneticFieldModel_t* (EMMagneticFieldModel)
  - *EMElectricFieldModel_t* (EMElectricFieldModel)
  - *EMConductivityModel_t* (EMConductivityModel)
  - *Descriptor_t* ({UserDefined})
  - *DataClass_t* (DataClass)
  - *DimensionalUnits_t* (DimensionalUnits)
  - *UserDefinedData_t* ({UserDefined})

4.36 FlowSolution_t

- Name
  - {UserDefined}
- Data-Type: M T
- Dimensions/DimensionValues
- Cardinality: Zero/N
- Child Nodes
  - *GridLocation_t* (GridLocation)
  - *DataArray_t* ({UserDefined})
  - *Rind_t* (Rind)
  - *DataClass_t* (DataClass)
  - *DimensionalUnits_t* (DimensionalUnits)

  - *Descriptor_t* ({UserDefined})
  - *UserDefinedData_t* ({UserDefined})

4.37 GasModel_t

- Name
  - GasModel
- Data-Type: C1
- Dimensions/DimensionValues
- Cardinality: Zero/One
- Child Nodes
  - *Descriptor_t* ({UserDefined})
  - *DataClass_t* (DataClass)
  - *DimensionalUnits_t* (DimensionalUnits)
  - *DataArray_t* ({UserDefined})
  - *UserDefinedData_t* ({UserDefined})

4.38 GeometryEntity_t

- Name
  - {UserDefined}
- Data-Type: M T
- Dimensions/DimensionValues
- Cardinality: Zero/N

4.39 GeometryFile_t

- Name
  - GeometryFile
- Data-Type: C1
- Dimensions/DimensionValues
- Cardinality: One/One

4.40 GeometryFormat_t

- Name
  - GeometryFormat
- Data-Type: C1
- Dimensions/DimensionValues
- Cardinality: One/One

4.41 GeometryReference_t

- Name
  - {UserDefined}
- Data-Type: M T
- Dimensions/DimensionValues
- Cardinality: Zero/N
- Child Nodes
  - *Descriptor_t* ({UserDefined})
  - *GeometryFile_t* (GeometryFile)
  - *GeometryFormat_t* (GeometryFormat)
  - *GeometryEntity_t* ({UserDefined})
  - *UserDefinedData_t* ({UserDefined})

4.42 GoverningEquations_t

- Name
  - GoverningEquations
- Data-Type: C1
- Dimensions/DimensionValues
- Cardinality: Zero/One
- Child Nodes
  - *Descriptor_t* ({UserDefined})
  - *DiffusionModel_t* (DiffusionModel)
  - *UserDefinedData_t* ({UserDefined})

4.43 Gravity_t

- Name
  - {UserDefined}
- Data-Type: M T
- Dimensions/DimensionValues
- Cardinality: Zero/One
- Child Nodes
  - *DataArray_t* (GravityVector)
  - *Descriptor_t* ({UserDefined})
  - *DataClass_t* (DataClass)
  - *DimensionalUnits_t* (DimensionalUnits)
  - *UserDefinedData_t* ({UserDefined})

4.44 GridConnectivity1to1_t

- Name
  - {UserDefined}
- Data-Type: C1
- Dimensions/DimensionValues
- Cardinality: Zero/N
- Child Nodes
  - *Transform_t"* (Transform)
  - *IndexRange_t* (PointRange)
  - *IndexRange_t* (PointRangeDonor)
  - *Ordinal_t* (Ordinal)
  - *GridConnectivityProperty_t* (GridConnectivityProperty)
  - *Descriptor_t* ({UserDefined})
  - *UserDefinedData_t* ({UserDefined})

4.45 GridConnectivityProperty_t

- Name
  - GridConnectivityProperty
- Data-Type: M T
- Dimensions/DimensionValues
- Cardinality: Zero/One
- Child Nodes

  - *Descriptor_t* ({UserDefined})
  - *UserDefinedData_t* ({UserDefined})
  - *Periodic_t* (Periodic)
  - *AverageInterface_t* (AverageInterface)

4.46 GridConnectivityType_t

- Name
  - GridConnectivityType
- Data-Type: C1
- Dimensions/DimensionValues
- Cardinality: One/One

4.47 GridConnectivity_t

- Name
  - {UserDefined}
- Data-Type: C1
- Dimensions/DimensionValues
- Cardinality: Zero/N
- Child Nodes
  - *GridLocation_t* (GridLocation)
  - *Ordinal_t* (Ordinal)
  - *Descriptor_t* ({UserDefined})
  - *IndexRange_t* (PointRange)
  - *IndexArray_t* (PointList)
  - *IndexArray_t* (PointListDonor)
  - *IndexArray_t* (CellListDonor)
  - *GridConnectivityProperty_t* (GridConnectivityProperty)
  - *GridConnectivityType_t* (GridConnectivityType)
  - *DataArray_t* (InterpolantsDonor)

4.48 GridCoordinates_t

- Name
  - GridCoordinates
  - {UserDefined}
- Data-Type: M T
- Dimensions/DimensionValues
- Cardinality: Zero/N
- Child Nodes
  - *DataArray_t* ({UserDefined})
  - *Rind_t* (Rind)
  - *DataClass_t* (DataClass)
  - *DimensionalUnits_t* (DimensionalUnits)
  - *Descriptor_t* ({UserDefined})
  - *UserDefinedData_t* ({UserDefined})

4.49 GridLocation_t

- Name
  - GridLocation
- Data-Type: C1
- Dimensions/DimensionValues
- Cardinality: Zero/One

4.50 IndexArray_t

- Name
  - PointList
  - PointListDonor
  - CellListDonor
  - InwardNormalList
- Data-Type: I4 R4 R8
- Dimensions/DimensionValues
- Cardinality: Zero/One

4.51 IndexRange_t

- Name
  - PointRange
  - PointRangeDonor
  - ElementRange
  - {UserDefined}
- Data-Type: I4
- Dimensions/DimensionValues
- Cardinality: Zero/One

4.52 IntegralData_t

- Name
  - {UserDefined}
- Data-Type: M T
- Dimensions/DimensionValues
- Cardinality: Zero/N
- Child Nodes
  - *Descriptor_t* ({UserDefined})
  - *DataClass_t* (DataClass)
  - *DimensionalUnits_t* (DimensionalUnits)
  - *DataArray_t* ({UserDefined})
  - *UserDefinedData_t* ({UserDefined})

4.53 InwardNormalIndex_t

- Name
  - InwardNormalIndex
- Data-Type: I4
- Dimensions/DimensionValues
- Cardinality: Zero/One

4.54 Ordinal_t

- Name
  - Ordinal
- Data-Type: I4
- Dimensions/DimensionValues
- Cardinality: Zero/One

4.55 OversetHoles_t

- Name
  - {UserDefined}
- Data-Type: M T
- Dimensions/DimensionValues
- Cardinality: Zero/N
- Child Nodes
  - *Descriptor_t* ({UserDefined})
  - *IndexArray_t* (PointList)
  - *GridLocation_t* (GridLocation)
  - *IndexRange_t* ({UserDefined})
  - *UserDefinedData_t* ({UserDefined})

4.56 Periodic_t

- Name
  - Periodic
- Data-Type: M T
- Dimensions/DimensionValues
- Cardinality: Zero/One
- Child Nodes
  - *DataClass_t* (DataClass)
  - *DimensionalUnits_t* (DimensionalUnits)
  - *Descriptor_t* ({UserDefined})
  - *UserDefinedData_t* ({UserDefined})
  - *DataArray_t* (RotationCenter)
  - *DataArray_t* (RotationAngle)
  - *DataArray_t* (Translation)

4.57 ReferenceState_t

- Name
  - ReferenceState
- Data-Type: M T
- Dimensions/DimensionValues
- Cardinality: Zero/One
- Child Nodes
  - *Descriptor_t* ({UserDefined})
  - *Descriptor_t* (ReferenceStateDescription)
  - *DataClass_t* (DataClass)
  - *DimensionalUnits_t* (DimensionalUnits)
  - *DataArray_t* ({UserDefined})
  - *UserDefinedData_t* ({UserDefined})

4.58 RigidGridMotion_t

- Name
  - {UserDefined}
- Data-Type: C1
- Dimensions/DimensionValues
- Cardinality: Zero/N
- Child Nodes
  - *DataClass_t* (DataClass)
  - *DimensionalUnits_t* (DimensionalUnits)
  - *Descriptor_t* ({UserDefined})
  - *UserDefinedData_t* ({UserDefined})
  - *DataArray_t* ({UserDefined})

4.59 Rind_t

- Name
  - Rind
- Data-Type: I4
- Dimensions/DimensionValues
- Cardinality: Zero/One

4.60 RotatingCoordinates_t

- Name
  - RotatingCoordinates
- Data-Type: M T
- Dimensions/DimensionValues
- Cardinality: Zero/One
- Child Nodes
  - *DataArray_t* (RotationCenter)
  - *DataArray_t* (RotationRateVector)
  - *DataClass_t* (DataClass)
  - *DimensionalUnits_t* (DimensionalUnits)
  - *Descriptor_t* ({UserDefined})
  - *UserDefinedData_t* ({UserDefined})

4.61 SimulationType_t

- Name
  - SimulationType
- Data-Type: C1
- Dimensions/DimensionValues
- Cardinality: One/One

4.62 ThermalConductivityModel_t

- Name
  - ThermalConductivityModel
- Data-Type: C1
- Dimensions/DimensionValues
- Cardinality: Zero/One
- Child Nodes
  - *Descriptor_t* ({UserDefined})
  - *DataClass_t* (DataClass)
  - *DimensionalUnits_t* (DimensionalUnits)
  - *DataArray_t* ({UserDefined})
  - *UserDefinedData_t* ({UserDefined})

4.63 ThermalRelaxationModel_t

- Name
  - ThermalRelaxationModel
- Data-Type: C1
- Dimensions/DimensionValues
- Cardinality: Zero/One
- Child Nodes
  - *Descriptor_t* ({UserDefined})
  - *DataClass_t* (DataClass)
  - *DimensionalUnits_t* (DimensionalUnits)
  - *DataArray_t* ({UserDefined})
  - *UserDefinedData_t* ({UserDefined})

4.64 Transform_t”

- Name
  - Transform
- Data-Type: I4
- Dimensions/DimensionValues
- Cardinality: Zero/One

4.65 TurbulenceClosure_t

- Name
  - TurbulenceClosure
- Data-Type: C1
- Dimensions/DimensionValues
- Cardinality: Zero/One
- Child Nodes
  - *Descriptor_t* ({UserDefined})
  - *DataClass_t* (DataClass)
  - *DimensionalUnits_t* (DimensionalUnits)
  - *DataArray_t* ({UserDefined})
  - *UserDefinedData_t* ({UserDefined})

4.66 TurbulenceModel_t

- Name
  - {UserDefined}
- Data-Type: C1
- Dimensions/DimensionValues
- Cardinality: Zero/One
- Child Nodes
  - *Descriptor_t* ({UserDefined})
  - *DataArray_t* ({UserDefined})
  - *UserDefinedData_t* ({UserDefined})
  - *DataClass_t* (DataClass)
  - *DimensionalUnits_t* (DimensionalUnits)
  - *DiffusionModel_t* (DiffusionModel)

4.67 UserDefinedData_t

- Name
  - {UserDefined}
- Data-Type: M T
- Dimensions/DimensionValues
- Cardinality: Zero/N
- Child Nodes
  - *Descriptor_t* ({UserDefined})
  - *GridLocation_t* (GridLocation)
  - *IndexRange_t* (PointRange)
  - *IndexArray_t* (PointList)
  - *DataClass_t* (DataClass)
  - *DimensionalUnits_t* (DimensionalUnits)
  - *DataArray_t* ({UserDefined})
  - *FamilyName_t* (FamilyName)
  - *UserDefinedData_t* ({UserDefined})
  - *Ordinal_t* (Ordinal)

4.68 ViscosityModel_t

- Name
  - ViscosityModel
- Data-Type: C1
- Dimensions/DimensionValues
- Cardinality: Zero/One
- Child Nodes
  - *Descriptor_t* ({UserDefined})
  - *DataClass_t* (DataClass)
  - *DimensionalUnits_t* (DimensionalUnits)
  - *DataArray_t* ({UserDefined})
  - *UserDefinedData_t* ({UserDefined})

4.69 WallFunctionType_t

- Name
  - WallFunctionType
- Data-Type: C1
- Dimensions/DimensionValues
- Cardinality: One/One

4.70 WallFunction_t

- Name
  - WallFunction
- Data-Type: M T
- Dimensions/DimensionValues
- Cardinality: Zero/One
- Child Nodes
  - *Descriptor_t* ({UserDefined})
  - *UserDefinedData_t* ({UserDefined})
  - *WallFunctionType_t* (WallFunctionType)

4.71 ZoneBC_t

- Name
  - ZoneBC
- Data-Type: M T
- Dimensions/DimensionValues
- Cardinality: Zero/One
- Child Nodes
  - *BC_t* ({UserDefined})
  - *ReferenceState_t* (ReferenceState)
  - *DataClass_t* (DataClass)
  - *DimensionalUnits_t* (DimensionalUnits)
  - *Descriptor_t* ({UserDefined})
  - *UserDefinedData_t* ({UserDefined})

4.72 ZoneGridConnectivity_t

- Name
  - ZoneGridConnectivity
- Data-Type: M T
- Dimensions/DimensionValues
- Cardinality: Zero/One
- Child Nodes
  - *GridConnectivity1to1_t* ({UserDefined})
  - *GridConnectivity_t* ({UserDefined})
  - *OversetHoles_t* ({UserDefined})
  - *Descriptor_t* ({UserDefined})
  - *UserDefinedData_t* ({UserDefined})

4.73 ZoneIterativeData_t

- Name
  - {UserDefined}
- Data-Type: M T
- Dimensions/DimensionValues
- Cardinality: Zero/One
- Child Nodes
  - *DataClass_t* (DataClass)

  - *DimensionalUnits_t* (DimensionalUnits)
  - *Descriptor_t* ({UserDefined})
  - *UserDefinedData_t* ({UserDefined})
  - *DataArray_t* ({UserDefined})

4.74 ZoneType_t

- Name
  - ZoneType
- Data-Type: C1
- Dimensions/DimensionValues
- Cardinality: One/One

4.75 Zone_t

- Name
  - {UserDefined}
- Data-Type: I4
- Dimensions/DimensionValues
- Cardinality: Zero/N
- Child Nodes
  - *GridCoordinates_t* (GridCoordinates)
  - *GridCoordinates_t* ({UserDefined})
  - *DiscreteData_t* ({UserDefined})
  - *Elements_t* ({UserDefined})
  - *ZoneBC_t* (ZoneBC)
  - *FlowSolution_t* ({UserDefined})
  - *ZoneType_t* (ZoneType)
  - *Ordinal_t* (Ordinal)
  - *ZoneGridConnectivity_t* (ZoneGridConnectivity)
  - *ZoneIterativeData_t* ({UserDefined})
  - *RigidGridMotion_t* ({UserDefined})
  - *ReferenceState_t* (ReferenceState)
  - *IntegralData_t* ({UserDefined})
  - *ArbitraryGridMotion_t* ({UserDefined})
  - *FamilyName_t* (FamilyName)
  - *FlowEquationSet_t* (FlowEquationSet)

- *ConvergenceHistory_t* (ZoneConvergenceHistory)
- *RotatingCoordinates_t* (RotatingCoordinates)
- *DataClass_t* (DataClass)
- *DimensionalUnits_t* (DimensionalUnits)
- *Descriptor_t* ({UserDefined})
- *UserDefinedData_t* ({UserDefined})

CHAPTER

FIVE

CGNS.PAT.CGNSERRORS

- *genindex*