Proposal for the addition of rigid body grid motion to the CGNS

March 2000

Presented by: Robert Bush, United Technology Research Center **Reviewed by:** Christopher Rumsey, NASA Langley Research Center

Diane Poirier, ICEM CFD Engineering

RigidGridMotion_t Data Structure

Adding the rigid body motion information to the CGNS file enables an application code to determine the mesh location without the need to alter the original mesh definition recorded under GridCoordinates_t. A new data structure named RigidGridMotion_t is created to record the necessary data defining a rigid translation and/or rotation of the grid coordinates.

It is proposed that the rigid grid motion be recorded independently for each zone of the CGNS base. Therefore the RigidGridMotion_t data structure would be added under each the zone data structure (Zone_t). There may be zero to several RigidGridMotion_t nodes under a Zone_t node. The multiple rigid grid motion definitions may be associated to different iteration or time step in the computation. This association is recorded under the ZoneIterativeData_t data structure.

SIDS definition of the RegionGridMotion_t data structure:

The RigidGridMotion_t under the Zone_t data structure:

The RigidGridMotion_t data structure:

```
RigidGridMotion t :=
List( Descriptor_t Descriptor1 ... DescriptorN ) ;
                                                                   (0)
RigidGridMotionType t RigidGridMotionType ;
                                                                   (r)
DataArray_t<real,2,PhysicalDimension, 2>OriginLocation ;
                                                                   (r)
DataArray_t<real,1,PhysicalDimension>RigidRotationAngle ;
                                                                   (o/d)
DataArray_t<real,1,PhysicalDimension>RigidVelocity ;
                                                                   (0)
DataArray_t<real,1,PhysicalDimension>RigidRotationRate ;
                                                                   (\circ)
List(DataArray_t DataArray1 ... DataArrayN ) ;
                                                                   (0)
DataClass_t DataClass ;
                                                                   (0)
DimensionalUnits_t DimensionalUnits ;
                                                                   (0)
```

Definitions:

☐ RigidGridMotionType_t: enumeration type that describes the type of rigid grid motion.

RigidGridMotionType_t	:=	Enumeration(
None,		
ConstantRate,		
VariableRate) :		

- OriginLocation: Physical coordinates of the origin before and after the rigid body motion.
- □ RigidRotationAngle: Rotation angles of about each axis of the translated coordinate system.
- RigidVelocity: Grid velocity vector of the origin translation.
- □ RigidRotationRate: Rotation rate vector about the about the axis of the translated coordinate system.

Notes:

- ☐ The DataClass_t, DimensionalUnits_t and Descriptor_t nodes may optionally be specified under the RigidGridMotion_t nodes.
- □ RigidGridMotionType, OriginLocation and RigidRotationAngle are the only three required data under RigidGridMotion_t. All other elements are optional.
- ☐ Any numbers of DataArray_t nodes are allowed. These should be used to record data not covered by this specification.
- RigidGridMotion_t implies relative motion of grid zones or blocks. However, no attempt is made here to require that the ZoneGridConnectivity_t information be updated to be consistent with the new grid locations. The user is responsible to ensure that any ZoneGridConnectivity_t information is kept up to date.

Proposed CGNS Library extensions:

□ Add a new routine to the CGNS API that would return the grid coordinates with the transformation (defined under the RigidGridMotion_t data structure) performed automatically, if desired.

ADF file mapping definition of the RegionGridMotion t data structure

Name: RigidGridMotion# (or user defined)

Label: RigidGridMotion_t

Data-Type: C1 Dimensions: 1 **Dimension Values:** length of string Data: RigidGridMotionType Value Cardinality: 0,N Name: OriginLocation Name: RigidRotationAngle Label: DataArrav t Label: DataArrav t Data-Type: R4 Data-Type: R4 **Dimensions: 2 Dimensions: 1** Dimension Values: Physical Dimension, 2 **Dimension Values:** Physical Dimension OriginReference, OriginNew Data: RigidRotationAngles Cardinality: 0,1 Cardinality: 1 Name: RigidVelocity Name: RigidRotationRate Label: DataArray_t Label: DataArray_t Data-Type: R4 Data-Type: R4 **Dimensions: 1 Dimensions: 1 Dimension Values:** Physical Dimension **Dimension Values:** Physical Dimension RigidVelocity Data: RigidRotationRate Data: Cardinality: 0,1 Cardinality: 0.1 Name: DataArray# (or user defined) Name: Descriptor# (or user defined) Label: DataArray_t Label: Descriptor_t Data-Type: user defined Data-Type: C1 Dimensions: user defined **Dimensions:** 1 Dimension Values: user defined Dimension Values: length of string Data: user defined Data: Description string Cardinality: 0,N Cardinality: 0,N Name: DimensionalUnits Name: DataClass Label: DataClass_t Label: DimensionalUnits_t Data-Type: C1 Data-Type: C1 **Dimensions: 2 Dimensions: 1 Dimension Values: (32,5)** Dimension Values: length of string Data: DimensionalUnits Values Data: DataClass Value Cardinality: 0,1 Cardinality: 0,1