

Scripting Versions of OpenSim C++ API Calls

As you look through the OpenSim doxygen or if you look at OpenSim API examples in C++, you may see objects/classes with names like `Array_<double>` or `Vec<3>`. These are called templated classes. Templates are advanced C++ constructs that are used extensively throughout the OpenSim API and Simbody API. If you see notation like `Array<double>` in the doxygen or C++ code that you are trying to replicate, this means you're working with a templated class and will need to find its appropriate mapping in the scripting environment.

C++ templates allow the compiler to automatically generate multiple new classes from a common code base. This approach is useful primarily for containers (e.g. `Array<double>`, `Array<int>`, `Array<string>`) since it avoids code duplication making the code easier to maintain; however, these templates exist only in C++ and do not map easily to scripting languages.

One way to work around this is to specialize templates into classes, give those classes unique names, and then use them in scripting. The table below lists template specializations used in OpenSim API (C++) & Doxygen and the corresponding named classes to be used in scripting:

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Math types

Matlab	C++
Vec2	SimTK::Vec<2>
Vec3	SimTK::Vec<3>
Vec4	SimTK::Vec<4>
Vec6	SimTK::Vec<6>
Mat33	SimTK::Mat<3, 3>
SpatialVec	SimTK::Vec<2, SimTK::Vec3>
Vector	SimTK::Vector_<double>
VectorVec3	SimTK::Vector_<SimTK::Vec3>
RowVector	SimTK::RowVector_<double>
RowVectorVec3	SimTK::RowVector_<SimTK::Vec3>
Matrix	SimTK::Matrix_<double>
MatrixVec3	SimTK::Matrix_<SimTK::Vec3>
MatrixOfSpatialVec	SimTK::Matrix_<SimTK::SpatialVec>
VectorOfSpatialVec	SimTK::Vector_<SimTK::SpatialVec>
VectorVec3	SimTK::Vector_<SimTK::Vec3>
Rotation	SimTK::Rotation_<double>
InverseRotation	SimTK::InverseRotation_<double>
Transform	SimTK::Transform_<double>
Inertia	SimTK::Inertia_<double>
MassProperties	SimTK::MassProperties_<double>
SimTKArrayCoordinateReference	SimTK::Array_<OpenSim::CoordinateReference>
ArrayDecorativeGeometry	SimTK::Array_<SimTK::DecorativeGeometry>
SimTKArrayString	SimTK::Array_<std::string>

SimTKArrayDouble	SimTK::Array_<double>
SimTKArrayVec3	SimTK::Array_<SimTK::Vec3>
SimTKArrayInt	SimTK::Array_<int>
SimTKArrayMobilizedBodyIndex	SimTK::Array_<MobilizedBodyIndex>
ArrayXYPoint	OpenSim::Array<XYPoint>
ArrayBool	OpenSim::Array<bool>
ArrayDouble	OpenSim::Array<double>
ArrayInt	OpenSim::Array<int>
ArrayVec3	OpenSim::Array<SimTK::Vec3>
ArrayStr	OpenSim::Array<std::string>

Types from the C++ Standard Library

StdVectorString	std::vector<std::string>
StdVectorUnsigned	std::vector<unsigned>
StdVectorInt	std::vector<int>
StdVectorDouble	std::vector<double>
StdVectorVec3	std::vector<SimTK::Vec3>
StdVectorMatrix	std::vector<SimTK::Matrix_<double>>
StdVectorState	std::vector<SimTK::State>

Sets

SetIKTasks	OpenSim::Set<OpenSim::IKTask>
SetMarkerPairs	OpenSim::Set<OpenSim::MarkerPair>
SetMeasurements	OpenSim::Set<OpenSim::Measurement>
SetTrackingTasks	OpenSim::Set<OpenSim::TrackingTask>
SetGeometry	OpenSim::Set<OpenSim::DisplayGeometry>
SetFunctions	OpenSim::Set<OpenSim::Function>
SetScales	OpenSim::Set<OpenSim::Scale>
SetModelComponents	OpenSim::Set<OpenSim::ModelComponent>
ModelComponentSetModelComponent	OpenSim::ModelComponentSet<OpenSim::ModelComponent>
SetMuscles	OpenSim::Set<OpenSim::Muscle>
SetWrapObject	OpenSim::Set<OpenSim::WrapObject>
SetFrames	OpenSim::Set<OpenSim::Frame>
ModelComponentSetFrames	OpenSim::ModelComponentSet<OpenSim::Frame>
SetBodies	OpenSim::Set<OpenSim::Body>
ModelComponentSetBodies	OpenSim::ModelComponentSet<OpenSim::Body>
SetBodyScales	OpenSim::Set<OpenSim::BodyScale>
SetCoordinates	OpenSim::Set<OpenSim::Coordinate>
ModelComponentSetCoordinates	OpenSim::ModelComponentSet<OpenSim::Coordinate>

SetJoints	OpenSim::Set<OpenSim::Joint>
ModelComponentSetJoints	OpenSim::ModelComponentSet<OpenSim::Joint>
SetConstraints	OpenSim::Set<OpenSim::Constraint>
ModelComponentSetConstraints	OpenSim::ModelComponentSet<OpenSim::Constraint>
SetForces	OpenSim::Set<OpenSim::Force>
ModelComponentSetForces	OpenSim::ModelComponentSet<OpenSim::Force>
SetExternalForces	OpenSim::Set<OpenSim::ExternalForce>
SetControllers	OpenSim::Set<OpenSim::Controller>
ModelComponentSetControllers	OpenSim::ModelComponentSet<OpenSim::Controller>
ModelComponentSetExternalForces	OpenSim::ModelComponentSet<OpenSim::ExternalForce>
SetContactGeometry	OpenSim::Set<OpenSim::ContactGeometry>
ModelComponentSetContactGeometry	OpenSim::ModelComponentSet<OpenSim::ContactGeometry>
SetActuators	OpenSim::Set<OpenSim::Actuator>
SetAnalysis	OpenSim::Set<OpenSim::Analysis>
SetControls	OpenSim::Set<OpenSim::Control>
SetMarkers	OpenSim::Set<OpenSim::Marker>
ModelComponentSetMarkers	OpenSim::ModelComponentSet<OpenSim::Marker>
SetPathWrap	OpenSim::Set<OpenSim::PathWrap>
SetProbes	OpenSim::Set<OpenSim::Probe>
ModelComponentSetProbes	OpenSim::ModelComponentSet<OpenSim::Probe>
SetPathPoint	OpenSim::Set<OpenSim::AbstractPathPoint>
SetMarkerWeights	OpenSim::Set<MarkerWeight>

ComponentList

ComponentsList	OpenSim::ComponentList<const OpenSim::Component>
ComponentListIterator	OpenSim::ComponentListIterator<const OpenSim::Component>
FrameList	OpenSim::ComponentList<const OpenSim::Frame>
FrameIterator	OpenSim::ComponentListIterator<const OpenSim::Frame>
BodyList	OpenSim::ComponentList<const OpenSim::Body>
BodyIterator	OpenSim::ComponentListIterator<const OpenSim::Body>
MuscleList	OpenSim::ComponentList<const OpenSim::Muscle>
MuscleIterator	OpenSim::ComponentListIterator<const OpenSim::Muscle>
ModelComponentList	OpenSim::ComponentList<const OpenSim::ModelComponent>
ModelComponentIterator	OpenSim::ComponentListIterator<const OpenSim::ModelComponent>
JointList	OpenSim::ComponentList<const OpenSim::Joint>
JointIterator	OpenSim::ComponentListIterator<const OpenSim::Joint>
ActuatorList	OpenSim::ComponentList<const OpenSim::Actuator>
ActuatorIterator	OpenSim::ComponentListIterator<const OpenSim::Actuator>
Thelen2003MuscleList	OpenSim::ComponentList<OpenSim::Thelen2003Muscle>
Thelen2003MuscleIterator	OpenSim::ComponentListIterator<const OpenSim::Thelen2003Muscle>

Millard2012EquilibriumMuscleList	OpenSim::ComponentList<OpenSim::Millard2012EquilibriumMuscle>
Millard2012EquilibriumMuscleIterator	OpenSim::ComponentListIterator<const OpenSim::Millard2012EquilibriumMuscle>

Outputs and Inputs

OutputDouble	OpenSim::Output<double>
OutputVec3	OpenSim::Output<SimTK::Vec3>
OutputTransform	OpenSim::Output<SimTK::Transform>
OutputVector	OpenSim::Output<SimTK::Vector>
OutputSpatialVec	OpenSim::Output<SimTK::SpatialVec>
InputDouble	OpenSim::Input<double>
InputVec3	OpenSim::Input<SimTK::Vec3>

DataTables and related classes

DataTable	OpenSim::DataTable_<double, double>
DataTableVec3	OpenSim::DataTable_<double, SimTK::Vec3>
DataTableUnitVec3	OpenSim::DataTable_<double, SimTK::UnitVec3>
DataTableQuaternion	OpenSim::DataTable_<double, SimTK::Quaternion>
DataTableVec6	OpenSim::DataTable_<double, SimTK::Vec6>
DataTableSpatialVec	OpenSim::DataTable_<double, SimTK::SpatialVec>
TimeSeriesTable	OpenSim::TimeSeriesTable_<double>
TimeSeriesTableVec3	OpenSim::TimeSeriesTable_<SimTK::Vec3>
TimeSeriesTableUnitVec3	OpenSim::TimeSeriesTable_<SimTK::UnitVec3>
TimeSeriesTableQuaternion	OpenSim::TimeSeriesTable_<SimTK::Quaternion>
TimeSeriesTableVec6	OpenSim::TimeSeriesTable_<SimTK::Vec6>
TimeSeriesTableSpatialVec	OpenSim::TimeSeriesTable_<SimTK::SpatialVec>
STOFileAdapter	OpenSim::STOFileAdapter_<double>
STOFileAdapterVec3	OpenSim::STOFileAdapter_<SimTK::Vec3>
STOFileAdapterUnitVec3	OpenSim::STOFileAdapter_<SimTK::UnitVec3>
STOFileAdapterQuaternion	OpenSim::STOFileAdapter_<SimTK::Quaternion>
STOFileAdapterVec6	OpenSim::STOFileAdapter_<SimTK::Vec6>
STOFileAdapterSpatialVec	OpenSim::STOFileAdapter_<SimTK::SpatialVec>
TableSource	OpenSim::TableSource_<SimTK::Real>
TableSourceVec3	OpenSim::TableSource_<SimTK::Vec3>
TableReporterDouble	OpenSim::TableReporter<SimTK::Real>
TableReporterVec3	OpenSim::TableReporter<SimTK::Vec3>
TableReporterSpatialVec	OpenSim::TableReporter<SimTK::SpatialVec>
TableReporterVector	OpenSim::TableReporter<SimTK::Vector>
ConsoleReporterVec3	OpenSim::ConsoleReporter<SimTK::Vec3>

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