

3D controls的开发与配置



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课程 4

- ArcGIS Engine 3D 库和控件
- 3D controls，Commands and tools（命令和工具）
- 3D 文档和数据源
- 3D 对象描述
- 方法和属性

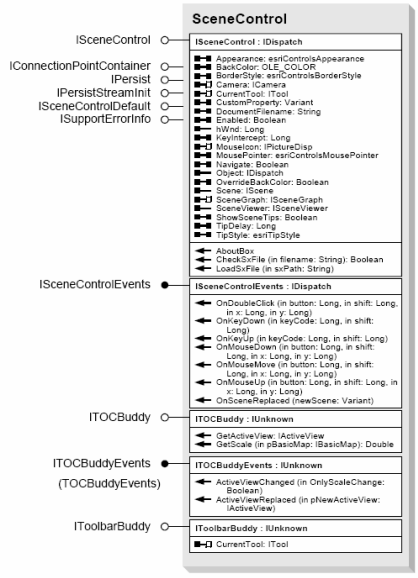
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Developing Applications with ArcGIS Engine 4-3

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Scene 控件

- SceneControl
  - 调入、调用SceneViewer class
  - 管理、操作
    - General appearance
    - Scene
    - Scene 图表、曲线图
    - 相机属性
  - 设置当前工具
  - 载入scene文档
- 库
  - SceneControl.ocx



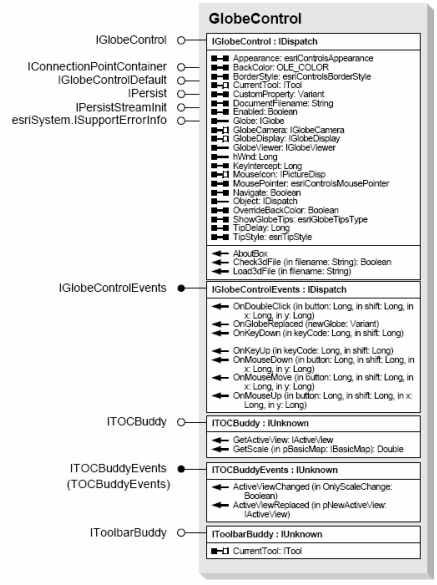
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The SceneControl functionalities

The SceneControl simplifies the development process by encapsulating coarse-grained ArcObjects, while still providing access to finer grained ArcObjects. The SceneControl encapsulates an object implementing ISceneViewer. This is the same ISceneViewer object found inside the ArcScene application. The ISceneViewer object contains a Camera and the Camera contains an Observer and Target position. The SceneControl provides shortcuts to frequently used properties and methods on the object it encapsulates. For example, the SceneControl has Camera, Scene, SceneGraph, and SceneViewer properties. The SceneControl also has some helper methods that perform common tasks. For example, the SceneControl has a LoadSxFile method for loading scene document. The SceneControl is typically a starting point for developing applications not only because it provides user interface, but by providing a direct route into the object model.

Globe 控件

- GlobeControl
  - 调入、调用 GlobeViewer class
  - 管理、操作
    - General appearance
    - Globe
    - Globe display
    - Globe camera properties
  - 设置当前工具
  - 载入globe文档
- 库
  - GlobeControl.ocx



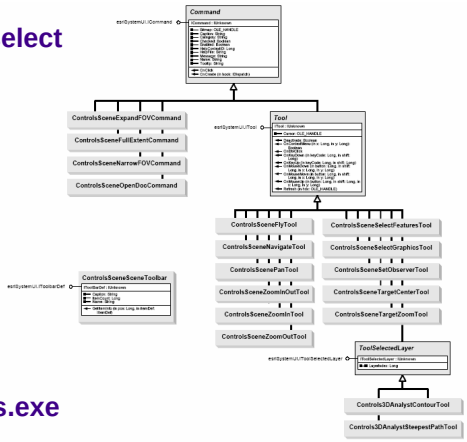
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The GlobeControl functionalities

The GlobeControl simplifies the development process by encapsulating coarse-grained ArcObjects, while still providing access to finer grained ArcObjects. The GlobeControl encapsulates an object implementing IGlobeViewer. This is the same IGlobeViewer object found inside the ArcGlobe application. The IGlobeViewer object contains a GlobeDisplay and the GlobeDisplay contains a Globe. The GlobeControl provides shortcuts to frequently used properties and methods on the object it encapsulates. For example, the GlobeControl has GlobeCamera, Globe, GlobeDisplay, and GlobeViewer properties. The GlobeControl also has some helper methods that perform common tasks. For example, the GlobeControl has a Load3dFile method for loading globe documents. The GlobeControl is typically a starting point for developing applications not only because it provides user interface, but by providing a direct route into the object model.

SceneControl 命令

- Commands 和 tools
  - Pan, zoom, fly, set observer, select
- Toolbars
  - ControlsSceneSceneToolbar
- 库
  - esriSceneControl.ocx
  - esri3DAnalyst.olb
- 引用
  - OMD, Tech docs or Categories.exe



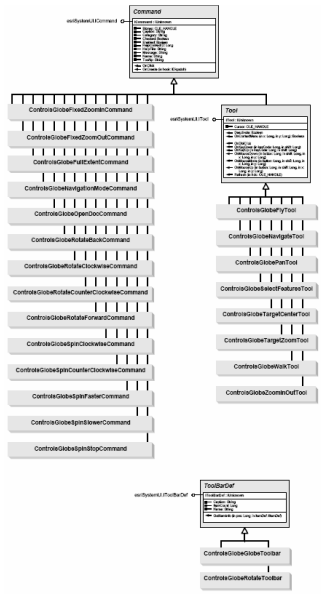
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Commands and tools available for the SceneControl

The 3DAnalyst library contains a set of commands, tools, and toolsets that work with the SceneControl to perform a specific action. For example, there are scene navigation commands and tools for moving the position of the camera. For a full list of the Scene Commands, including the GUID of each Command and a description of each Command, see ‘Names and IDs of the ControlCommands’ in the Developer Help.

GlobeControl 命令

- Commands 和 tools
  - Pan, zoom, fly, target, select
- Toolbars
  - ControlsGlobeGlobeToolbar
  - ControlsGlobeRotateToolbar
- Library
  - esriGlobeControl.ocx
  - esriGlobeCore.olb
- References
  - OMD, Tech docs or Categories.exe



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Commands and tools available for the GlobeControl

The esriGlobeCore library contains a set of commands, tools and toolsets that work with the GlobeControl to perform a specific action. For example, there are a set of commands to spin the globe. For a full list of the Globe Commands, including the GUID of each Command and a description of each Command, see ‘Names and IDs of the ControlCommands’ in the Developer Help.

加入 3D controls Item到toolbars

```
Private Sub TabControl1_Click(ByVal sender As Object, ByVal e As
   System.EventArgs) Handles TabControl1.Click
   If TabControl1.SelectedTab Is tbpgSceneCtrl Then
   'Scene
         …
   ElseIf TabControl1.SelectedTab Is tbpgGlobeCtrl Then
   'Globe
         AxToolbarControl1.SetBuddyControl(AxGlobeControl1)
         AxToolbarControl1.RemoveAll()
         Functions.AddGlobeCommands(AxToolbarControl1)
         AxTOCControl1.SetBuddyControl(AxGlobeControl1)
         Functions.SetCurrentTool(AxToolbarControl1, 1)
   End If
End Sub

Public Shared Sub AddGlobeCommands(ByRef toolBarControl As AxToolbarControl)
   toolBarControl.AddItem("esriGlobeCore.ControlsGlobeOpenDocCommand", , -1,
   False, , esriCommandStyles.esriCommandStyleIconOnly)
   toolBarControl.AddItem("esriGlobeCore.ControlsGlobeGlobeToolbar", , -1, True,
   , esriCommandStyles.esriCommandStyleIconOnly)
   toolBarControl.AddItem("esriGlobeCore.ControlsGlobeRotateToolbar", , -1,
   True, , esriCommandStyles.esriCommandStyleIconOnly)
End Sub
```

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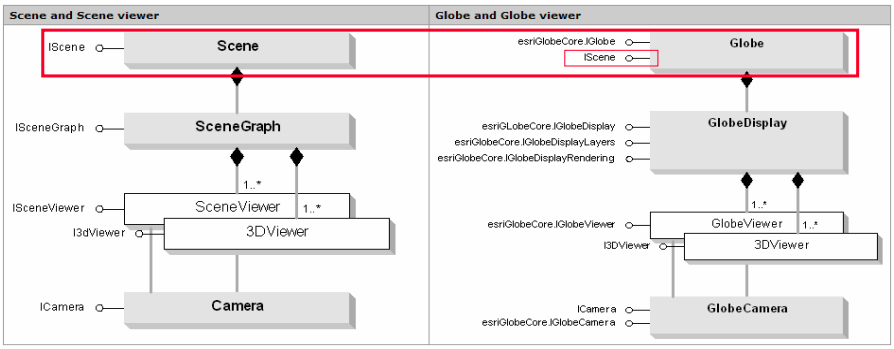
Adding items to the toolbar

The code in the slide shows the use of IToolbarControl::AddItem to add the command ControlsGlobeOpenDocCommand to the toolbar control as well as the two Globe toolbars: ControlsGlobeGlobeToolbar and the ControlsGlobeRotateToolbar.

Notice the sequence of changing the buddy, removing all existing commands and loading new ones on the toolbar control AxToolbarControl1. This is needed when one toolbar control needs to accommodate the active buddy control (SceneControl or GlobeControl) with the appropriate set of commands and tools.

Scene 和Globe

- 维护 一系列2D 和3D 图层
- 和MapControl中的Map CoClass相似
- 每个控件一个对象



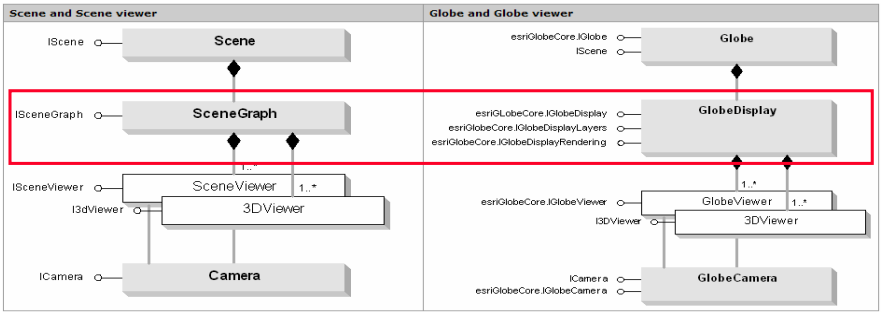
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Similar 3D objects

The SceneControl and the GlobeControl have similar 3D objects with similar functionalities. The scene viewer represents a 3D display window in the SceneControl. The equivalent in the GlobeControl is the globe viewer. Both controls support one or more viewers. The primary viewer is displayed in the main control window. Sub-viewers are opened in separate floating windows. The viewer with current focus is referred to as the ActiveViewer. The perspective of a scene viewer is controlled by the Camera of the Scene (the equivalent for Globe is GlobeCamera). I3DViewer extracts some common properties and methods applicable to both scene and globe viewers and adds others (e.g., full screen viewing) so it can be used by both a Scene and a Globe.

SceneGraph 和 GlobeDisplay

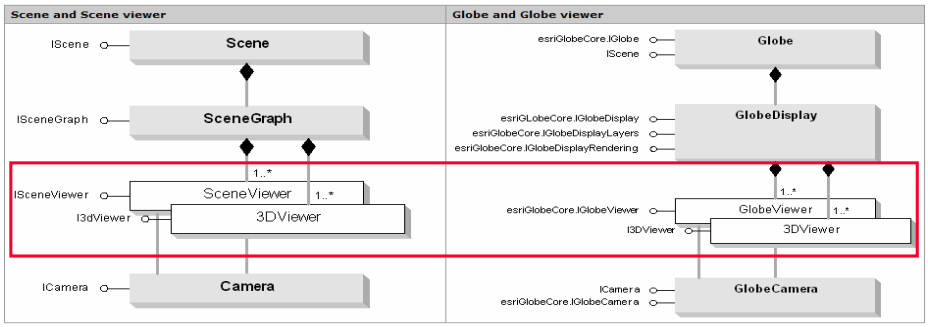
- 管理所有视图 (窗口)
  - Add, remove, set active, refresh
- 允许改变显示属性
  - Vertical exaggeration, extent, contrast
- 控制internal caches



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SceneViewer和GlobeViewer

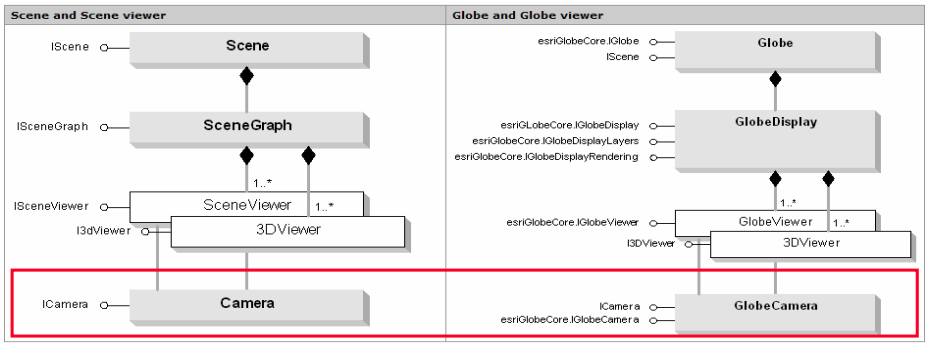
- Modeless 3D显示窗口
- Window the with current focus is the active viewer
- 通过不同角度显示3D数据
- 3DViewer
  - Full-screen viewing, access to camera and hdc …



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Camera and GlobeCamera

- Control the perspective of the viewers
  - Observer, target, azimuth, inclination, pan
- Only one camera for each viewer
  - Camera: works with local coordinate system
  - GlobeCamera: works with latitude and longitude



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导入3D文档

- ISceneControl/IGlobeControl
  - CheckSxFile/Check3DFile
  - LoadSxFile/Load3DFile
  - ShowSceneTips/ShowGlobeTips
  - TipStyle（提示类型）
  - TipDelay（提示延迟）

```
Private Sub Form1_Load(…) Handles MyBase.Load
    Dim fileName As String = "C:\Program Files\ArcGIS\ArcGlobeData\Default_Document.3dd"
    If AxGlobeControl1.Check3dFile(fileName) Then
        AxGlobeControl1.Load3dFile(fileName)
        AxGlobeControl1.TipDelay = 500
        AxGlobeControl1.TipStyle = esriTipStyle.esriTipStyleTransparent
        AxGlobeControl1.ShowGlobeTips = esriGlobeTipsType.esriGlobeTipsTypeLatLon
    End If
End Sub
```

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Loading 3D documents

Similar the to the .mxd ArcMap document, the .sxd and .3dd documents are generated by ArcScene and ArcGlobe respectively. These documents can be loaded into their respective controls using the LoadSxFile and Load3DFile.

Although not directly related to loading 3D documents, the tip related methods and code are included in this slide for two reasons: 1) they are part of the same ISceneControl/IGlobeControl interfaces; 2) it is a good practice to set the tip properties as early as loading the 3D documents.

访问地图文档（MapDocument）

- 可以访问来源于 mxd, lyr, pmf文件的图层

```
'Open a file dialog for selecting map documents
OpenFileDialog1.Title = "Add Data"
OpenFileDialog1.Filter = "Layer Files (*.lyr)|*.lyr|Map Documents (*.mxd)|*.mxd"
OpenFileDialog1.InitialDirectory = "c:\student\daae\data\"
If (OpenFileDialog1.ShowDialog() <> DialogResult.OK) Then Exit Sub

Dim sFilePath As String
sFilePath = OpenFileDialog1.FileName

Dim mapDocument As IMapDocument = New MapDocument
If (Not mapDocument.IsMapDocument(sFilePath)) Then Exit Sub

mapDocument.Open(sFilePath)
Dim scene As IScene
If TabControl1.SelectedTab Is tbpgSceneCtrl Then
   'Scene
   scene = AxSceneControl1.Scene
   scene.AddLayers(map.Layers, False)
ElseIf TabControl1.SelectedTab Is tbpgGlobeCtrl Then
   'Globe
   scene = AxGlobeControl1.GlobeDisplay.Scene
   scene.AddLayers(map.Layers, False)
End If
```

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Loading data using the MapDocument

The MapDocument CoClass encapsulates map document files (*.mxd, *mxt, *.pmf) and layer files (*.lyr). Instead of using ObjectCopy and IMap to clone the content of the MapDocument and load it into the SceneControl or the GlobeControl, IBasicMap can be used.

The following code has the same effect of loading the data with the only exception that both the SceneControl and the MapControl will be pointing to the same address of data in memory; hence zooming in on one will force a zoom in on the other.

```
Dim basicMap As IBasicMap

Set basicMap = mapDocument.Map(0)

…
scene.AddLayers(basicMap.Layers, False)
```

使用WorkspaceFactory访问数据

- 使用workspace factories
  - 比如： RasterWorkspacefactory
- 创建和添加图层到IScene

```
'Open a file dialog to add data
OpenFileDialog1.Filter = "Raster Files (*.tif)|*.tif|All files (*.*)|*.*"
If (OpenFileDialog1.ShowDialog() <> DialogResult.OK) Then Exit Sub
file = OpenFileDialog1.FileName
Try
    filePath = file.Substring(0, file.LastIndexOf("\"))
    fileName = file.Substring(file.LastIndexOf("\") + 1)
    fileExtension = file.Substring(file.LastIndexOf(".") + 1).ToLower
    WSFact = New RasterWorkspaceFactory
    RasterWorkspace = WSFact.OpenFromFile(filePath, 0)
    RasterDataset = RasterWorkspace.OpenRasterDataset(fileName)
    Rasterlayer = New RasterLayer
    Rasterlayer.CreateFromDataset(RasterDataset)
    layer = Rasterlayer
    m_scene.AddLayer(layer)
Catch ex As Exception
```

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Using the WorkspaceFactory to load data

In the code snippet above, a RasterWorkspaceFatory is used to create a RasterDataset. The method IRasterLayer::CreateFromDataset is then used to populate a new RasterLayer. Finally this RasterLayer is added as ILayer to the SceneControl using IScene:Addlayer.

在Globe中支持的数据源

- 在 Scene and Map中不相似的, 所有数据源必须拥有一个已经定义的空间参考
- The spatial reference can be in any geographic or projected coordinate systems
- 在 9.0, 有一些数据源是不被支持
  - 跟踪分析图层（Tracking Analyst Layers）
  - 草图层（Survey Layers）
  - 统计图层（Geostatistics Layers）
  - TINs 不直接支持; 需要修改成栅格（need to be converted to rasters）

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Data Sources in Globe

One major difference between the Globe object and Scene (and map) is that as a prerequisite, any layer intended to be used in the application must have a spatial reference defined to it. There are many different types of layers that can be added to the globe. Different data sources often have an associated layer responsible for displaying the data on the globe; vector features are handled by the FeatureLayer object, Raster data (both image and surface data) by the RasterLayer, and so on.

At 9.0, the following data sources are not supported: Tracking Analyst Layers, Survey Layers, Geostatistics Layers, and TINs. TINS, however can be converted into rasters before loading them into Globe.

3D controls: 事件

- ISceneControlEvents/IGlobeControlEvents
  - OnDoubleClick
  - OnSceneReplaced /OnGlobeReplaced
  - OnKeyDown/Up
  - OnMouseDown/Move/Up
- ITOCBuddyEvents
  - ActiveViewChanged/Replaced

```
Private Sub AxGlobeControl1_OnGlobeReplaced(…) Handles AxGlobeControl1.OnGlobeReplaced
    Dim pglbbDispRend As IGlobeDisplayRendering
    pglbbDispRend = AxGlobeControl1.GlobeDisplay
    Dim bsun As Boolean
    bsun = pglbbDispRend.IsSunEnabled
    If bsun = True Then chkSun.Checked = True
    'Get the state of globetips from the loaded doc
    m_penumTips = AxGlobeControl1.GlobeViewer.GlobeDisplay.Globe.ShowGlobeTips
End Sub
```

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Events of the 3D controls

The 3D controls fire events in response to keyboard and mouse interactions by the end user. Other events fire in response to actions occurring within the controls. For example, when a globe document is loaded into the GlobeControl, the OnGlobeReplaced event is fired.

SceneGraph/GlobeDisplay 事件

- ISceneGraphEvents/IGlobeDisplayEvents
  - ActiveViewerChanged
  - AfterDraw/BeforeDraw
  - InteractionStopped
  - TileOverflow/VectorOverflow
  - ViewerAdded/ViewerRemoved

```
Public WithEvents m_pglbDisplay As GlobeDisplay
…
Private Sub m_pglbDisplay_AfterDraw(ByVal pViewer As ESRI.ArcGIS.Analyst3D.ISceneViewer)
   Handles m_pglbDisplay.AfterDraw
   If (chkStartStop.CheckState = CheckState.Checked) Then
       Dim globeDisplay As IGlobeDisplay
       globeDisplay = m_globe.GlobeDisplay
       If (Not globeDisplay.IsNavigating) Then
          ' Capture key frames after globe is done drawing
          Functions.CaptureKeyFrame(m_globe, m_animTrack)
          lstKeyFrames.Items.Add(m_animTrack.Keyframe(m_animTrack.KeyframeCount - 1).Name)
       End If
    End If
End Sub
```

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Drawing events

ISceneGraphEvents and IGlobeDisplayEvents provide the 3D controls with access to events that occur when the states of the scene graph and the globe display change.

In the ArcGIS Developer Help, the event AfterDraw is available in both GlobeDisplay interfaces: the IGlobeDisplayEvents and the outbound interface IActiveViewEvents. One might ask out of which interface AfterDraw should be used. The short answer to this question is to listen to IGLobeDisplayEvents::AfterDraw. In fact, IActiveViewEvents has methods like AfterDraw*, AfterItemDraw, FocusMapChanged, SpatialRefrenceChanged, and ViewerRefreshed that are not applicable to the GlobeDisplay. However, ContentsChanged, ContentsCleared, ItemAdded, ItemDeleted, and ItemReordered are all valid events fired by IActiveViewEvents as implemented by the GlobeDisplay coclass. The reason why some methods that are not applicable are available, is because several coclasses implement the same IActiveViewEvents interface and each of them fire (or do not fire) events in different manner. As an example, the help reads “the Map object does not fire the FocusMap changed event whereas the PageLayout object does.” Both FocusMap and PageLayout coclasses implement IActiveViewEvents.

In general, use IActiveviewEvents to get the above applicable events that are common through the ArcGIS apps (map, scene etc.) and use IGlobeDisplayEvents to get events that relate to the Globe data generation, navigation, addition/removal of a viewer, and so on.

* AfterDraw can actually be fired in certain cases in globe, for example, when changing the default Transformation method.

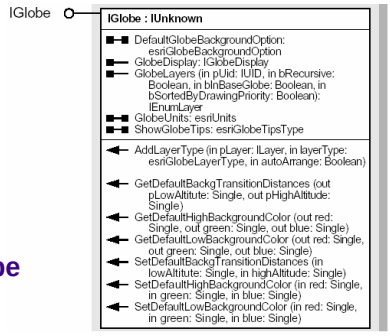
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与 Globe layers一起工作

- IGlobe
  - AddLayerType: 大多数数据类型
- Layer types
  - 正面图: 对于 globe用栅格来做其的表面
  - 渲染:渲染表面关于globe
  - Floating: 上面或下面进行偏移关于 globe surface 表面
- 可以设置背景选项
  - Sky, space color, fading tan …



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Globe layers

Layers in the GlobeControls are categorized according to their type. They are classified as elevation, draped, or floating. Elevation layers are raster sources with height information. They give the globe surface terrain. Draped layers are features or rasters that use the elevation layers as a source of their base heights. These layers appear draped over the globe surface. Floating layers are features or rasters that float independently of the terrain surface. They appear offset from other layers, either draped on discrete surfaces or set to some constant elevation.

Use IGlobe::AddlayerType to add layer to GlobeControl as the specified type.

The esriGlobeLayerType Constants types are:

esriGlobeLayerTypeUnknown	0	Add layer as base image.
esriGlobeLayerTypeDraped	1	Add layer as base image
esriGlobeLayerTypeElevation	2	Add layer as elevation.
esriGlobeLayerTypeFloating	3	Add layer as floating

GlobeControl: 浮动图层

- Can raise or lower a floating layer above or below the globe surface by assigning a vertical height
- IGlobeHeightProperties
  - BaseOption: esriGlobeLayerBaseSelf (original layer height)
  - Offset: Height above or below the globe

```
Private Sub TrackBar2_Scroll(ByVal sender As System.Object, ByVal e As System.EventArgs)
   Handles TrackBar2.Scroll
…
   While Not layer Is Nothing
      If layer.Name = "Countries" Then
         globeLayerProperties = globeDisplayLayers.FindGlobeProperties(layer)
         globeHeightProperties = globeLayerProperties.HeightProperties
         globeHeightProperties.BaseOption = esriGlobeLayerBaseOption.esriGlobeLayerBaseSelf
         globeHeightProperties.Offset = TrackBar2.Value * 500000
         globeHeightProperties.Apply(AxGlobeControl1.Globe, layer)
         AxGlobeControl1.GlobeDisplay.RefreshViewers()
      End If
      layer = enumlayer.Next
   End While
End Sub
```

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Offsetting a floating layer

To float a layer on a surface independent of the globe surface, add that layer as a floating layer, set its IGlobeHeightProperties::BaseOption to be esriGlobeLayerBaseSelf, assign a double value to IGlobeHeightProperties::Offset, and apply the changes with IGlobeHeightProperties::Apply.

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Globe: 不固定图层的偏移修改

- 通过设置一个垂直高度来提高或降低一个的图层在globe
- IGlobeHeightProperties
  - BaseOption: esriGlobeLayerBaseSelf (original layer height)
  - Offset: 设置高或底在globe中，来实现偏移

```
Private Sub TrackBar2_Scroll(ByVal sender As System.Object, ByVal e As System.EventArgs)
   Handles TrackBar2.Scroll
…
   While Not layer Is Nothing
      If layer.Name = "Countries" Then
         globeLayerProperties = globeDisplayLayers.FindGlobeProperties(layer)
         globeHeightProperties = globeLayerProperties.HeightProperties
         globeHeightProperties.BaseOption = esriGlobeLayerBaseOption.esriGlobeLayerBaseSelf
         globeHeightProperties.Offset = TrackBar2.Value * 500000
         globeHeightProperties.Apply(AxGlobeControl1.Globe, layer)
         AxGlobeControl1.GlobeDisplay.RefreshViewers()
      End If
      layer = enumlayer.Next
   End While
End Sub
```

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Offsetting a floating layer

To float a layer on a surface independent of the globe surface, add that layer as a floating layer, set its IGlobeHeightProperties::BaseOption to be esriGlobeLayerBaseSelf, assign a double value to IGlobeHeightProperties::Offset, and apply the changes with IGlobeHeightProperties::Apply.

练习 4

- 创建一个3D控件应用程序
- 使用3D document 和数据源
- 使用一些控件成员
- Drape a raster over the Scene surface
- 创建，播放和保存Globe动画

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课程 4回顾

- SceneControl 和 GlobeControl之间主要区别?
- 在3D控件里载入数据的三种方法?
- Globe图层的三种不同类型?
- Which Globe layer type can you apply an offset to?
- Name the method that adds key frames to the animation track?
- What are the steps for capturing and playing animation in Globe?

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