EXERCISE 6 - SMARTADAPT SCRIPTING

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VARIAN ONCOLOGY SYSTEMS

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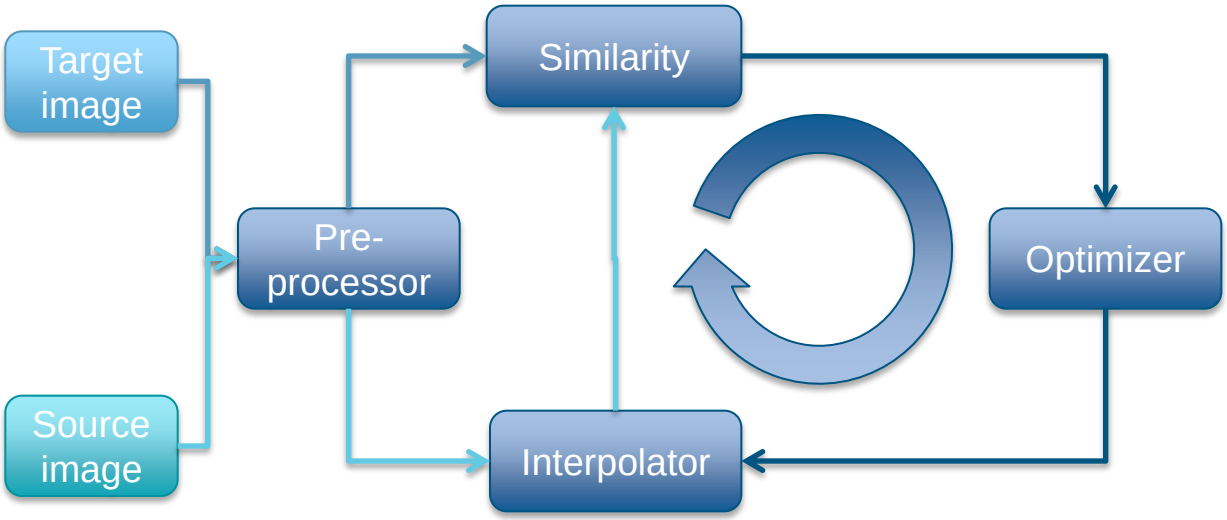
Exercise 6 Learning Goals

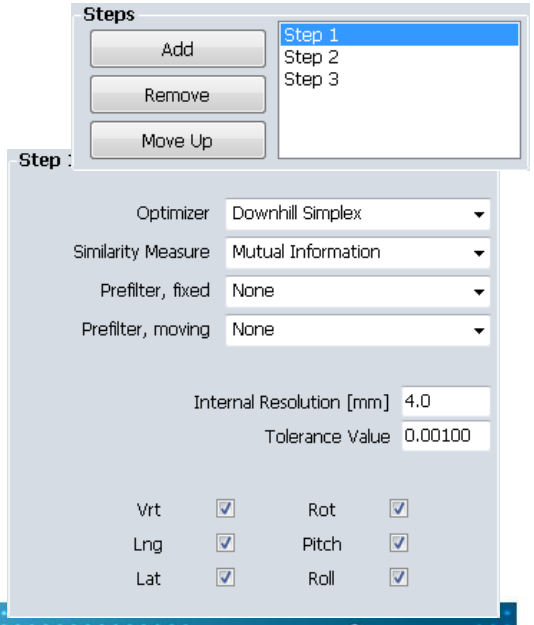
We will:

1) Learn more about SmartAdapt, registrations, and registration error.
2) Understand how to get started scripting with SmartAdapt.
3) Walk through an existing script to learn SmartAdapt API features.

Rigid Registration

- Multiple rigid registrations between data sets
  - Automated
  - Point based
  - Chained registrations, Inverse,
  - Visualization of Online and Offline registrations
- Flexible, user configurable registration framework allowing the user to apply different types of optimizers, similarity measures, preprocessors and interpolators





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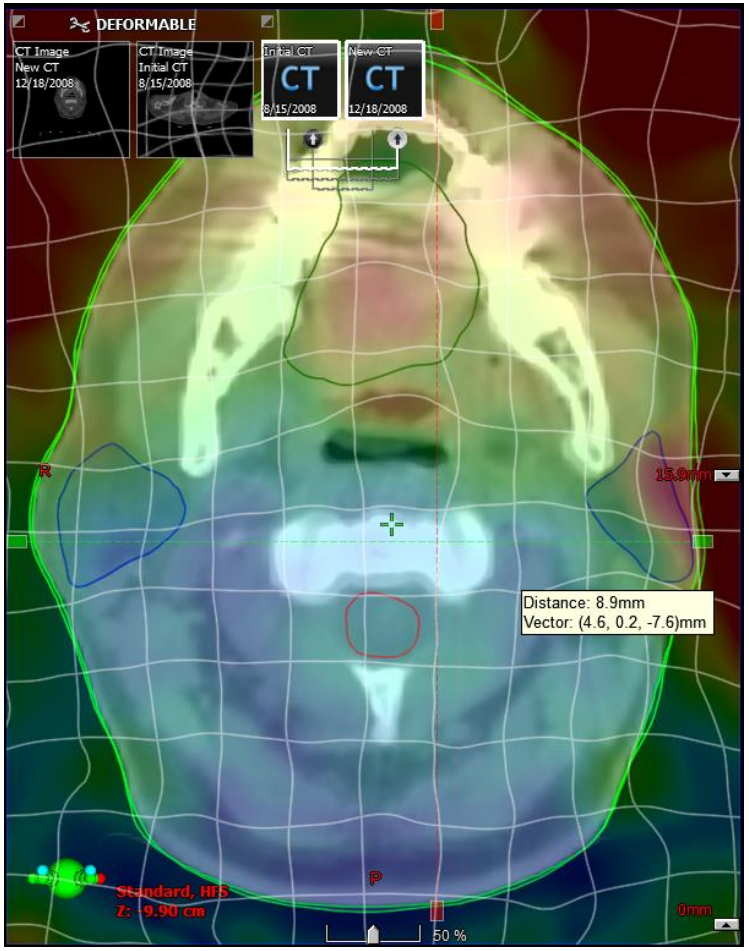
Deformable Image Registration

- Multiple deformable registrations between data sets
  - User controlled VOI
- Modality specific algorithms
  - Accelerated demons algorithm
    - CT-CT
    - CT-CBCT
    - CT-PET (via attenuation correction CT)
  - Radial Basis Function based algorithm
    - MR-MR
    - MR-CT
- Inversion of deformable registration with inverse consistency obtained by scattered data interpolation algorithm



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Deformable Image Registration

- Accelerated demons algorithm
  - The driving forces for the demons are based on the intensity differences between the two images, as well as the gradient of the image object.
  - Source image morphed voxel-by-voxel
- Radial Basis Function based algorithm
  - Parzen likelihood, a derivative of the conventional Mutual Information measure drives the optimization
  - Transformation modeled by adaptive, grid based Gaussian RBF

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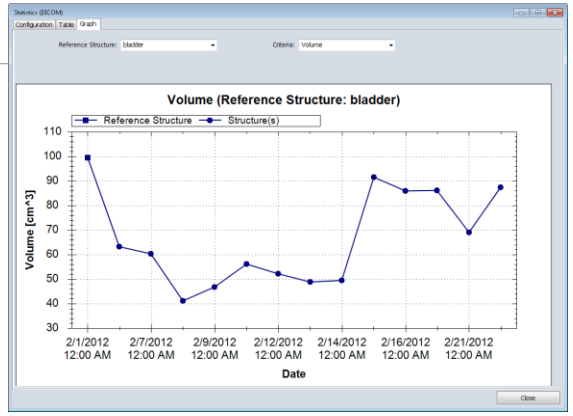
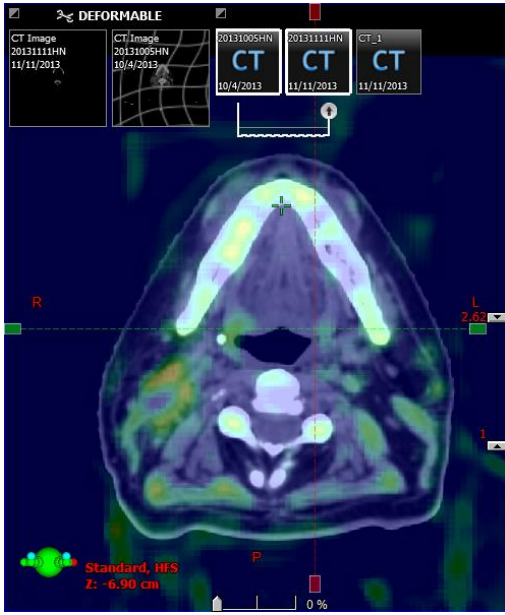
Display and analysis

- Display of computed transformations
  - Rotation and translation
  - Deformation grid, displacement color overlay, displacement components,
  - Point statistics for point based registrations
- Display of structure overlay and structure change trends
  - shift, volume, Dice





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Landmark based analysis of deformable and rigid registrations

- Quantitative technique
  - Assessment of accuracy within volumes of interest
  - Possible to detect max errors
  - Manual definition of landmarks

Landmark based analysis of deformable and rigid registrations

- Landmarks can be defined by using Point Match
  - Create new manual registration
  - Enter point match and define corresponding point pairs
    - RMC to add more points
- Click Point Match again to exit point match mode
- Point structures “Match Points” will be defined in the structure sets
- Scripting for reporting results

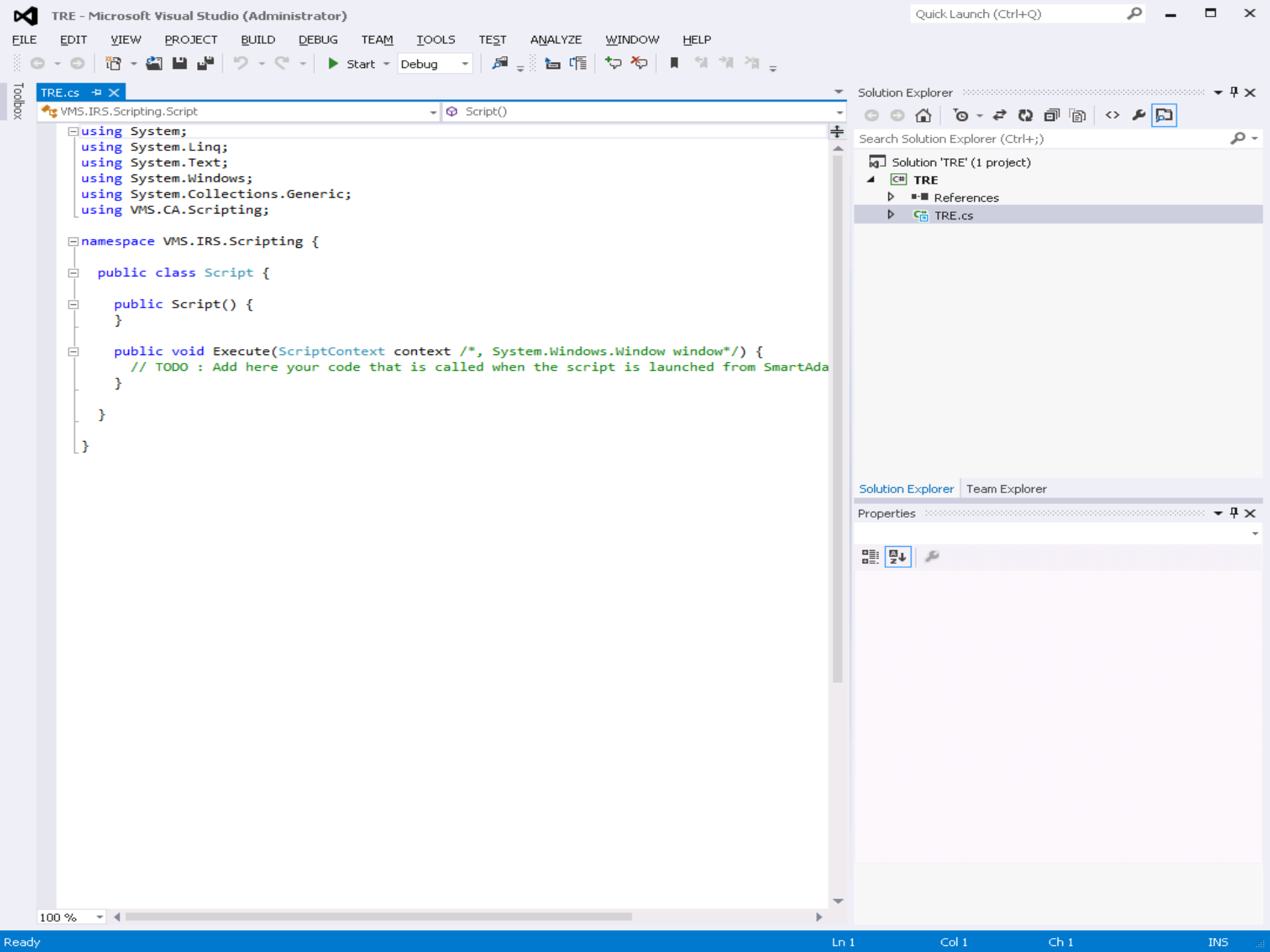
Exercise 6 – Step 0

1) Navigate to SmartAdapt.
2) Load case “Roer”

3) [Tomasz]

Exercise 6 – Plugin Script – Step 1

1) Navigate to SmartAdapt.
2) ? / Scripting API Help.
3) Tools / ScriptWizard.
4) Create a Single-file plugin script and name it “Hello”,
5) Open project in Visual Studio.
6) Double click file “Hello.cs” to open it.


TRE - Microsoft Visual Studio (Administrator)
Quick Launch (Ctrl+Q)
FILE EDIT VIEW PROJECT BUILD DEBUG TEAM TOOLS TEST ANALYZE WINDOW HELP
Start
Debug
Toolbox
TRE.cs
VMS.IRS.Scripting.Script
Script()
using System;
using System.Linq;
using System.Text;
using System.Windows;
using System.Collections.Generic;
using VMS.CA.Scripting;
namespace VMS.IRS.Scripting {
public class Script {
public Script() {
}
public void Execute(ScriptContext context /*, System.Windows.Window window*/) {
// TODO : Add here your code that is called when the script is launched from SmartAda
}
}
}
Solution Explorer
Search Solution Explorer (Ctrl+;)
Solution 'TRE' (1 project)
TRE
References
TRE.cs
Solution Explorer
Team Explorer
Properties
100 %
Ready
Ln 1
Col 1
Ch 1
INS

SmartAdapt Plugin - C# Syntax Notes

```
using System;
using System.Linq;
using System.Text;
using System.Windows;
using System.Collections.Generic;
using VMS.CA.Scripting;

namespace VMS.IRS.Scripting {

  public class Script {

    public Script() {
    }

    public void Execute(ScriptContext conte
      // TODO : Add here your code that is
    }
```

C# imports - similar to C++ '#include', java & python 'import'.

Plug-in definitions this code helps SmartAdapt detect the plugin and load it.

The real code starts here.

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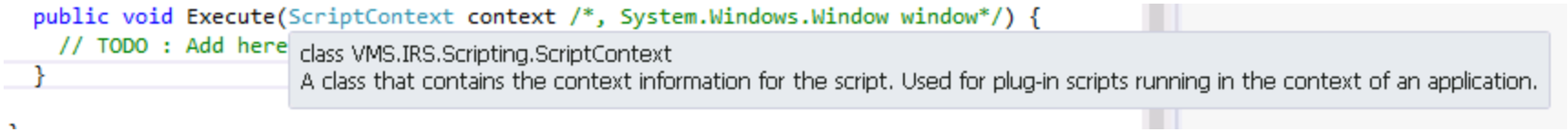
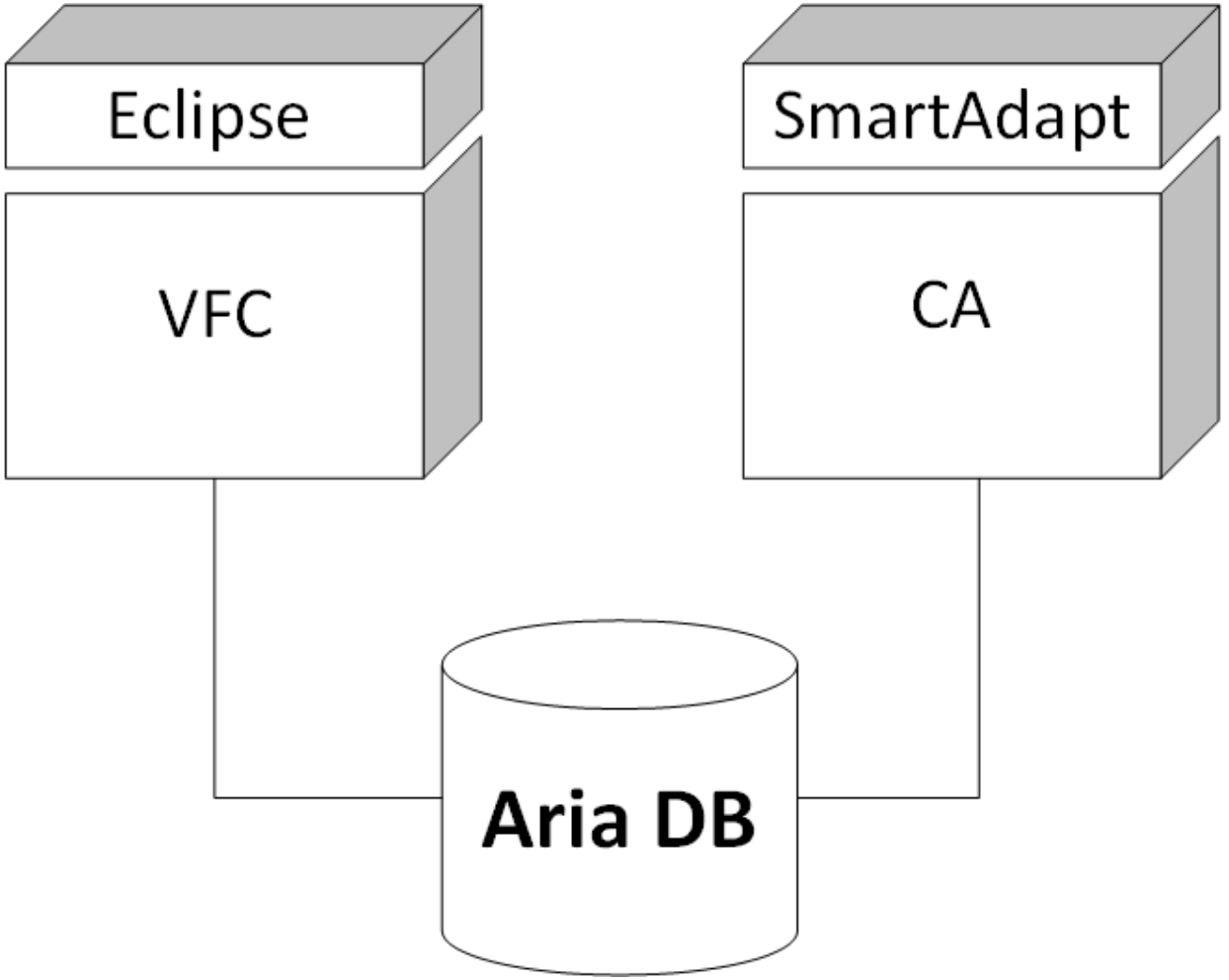
SmartAdapt Context

- SmartAdapt passes application context through variable ScriptContext.



- See Online Help (OLH) for VMS.IRS.Scripting.ScriptContext.

Technology Stacks



SmartAdapt Context (OLH)

Properties

	Name	Description
	CurrentUser	The currently logged in user of the application. (Inherited from ScriptContext .)
	Image	The active 3D image if a single 3D image is active. The value may be null if the context has no image.
	Patient	The patient. The value may be null if the context has no patient.
	Registration	The active rigid or non-rigid registration, if one is active. The value may be null if the context has no registration.
	Structure	The selected structure if one is selected. The value may be null if the context has no structure.
	ViewingCenterPoint	The center point of the three orthogonal views in Dicom coordinates of the registered (fixed) image.

Exercise 6 – HTML Registration Report.

1) In SmartAdapt, Open ROER case.
2) Tools/Scripts…
3) Change directory to ***C:\variandeveloper\Developer Workshop 2.0\exercise 6\SmartAdapt Scripting API\Plugins\TRE.cs***.
4) Run the TRE.cs script for the different registrations.

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Target Registration Error

(..) the "target registration error" at a spatial position F, denoted TRE(r), which is the distance between this point and the corresponding point in the other space after registration has been performed (*)

(*) J. Michael Fitzpatrick et al, “Derivation of Expected Registration Error for Point-based Rigid-body Registration”, Part of the SPIE Conference on Image Processing. San Diego. California, February 1998

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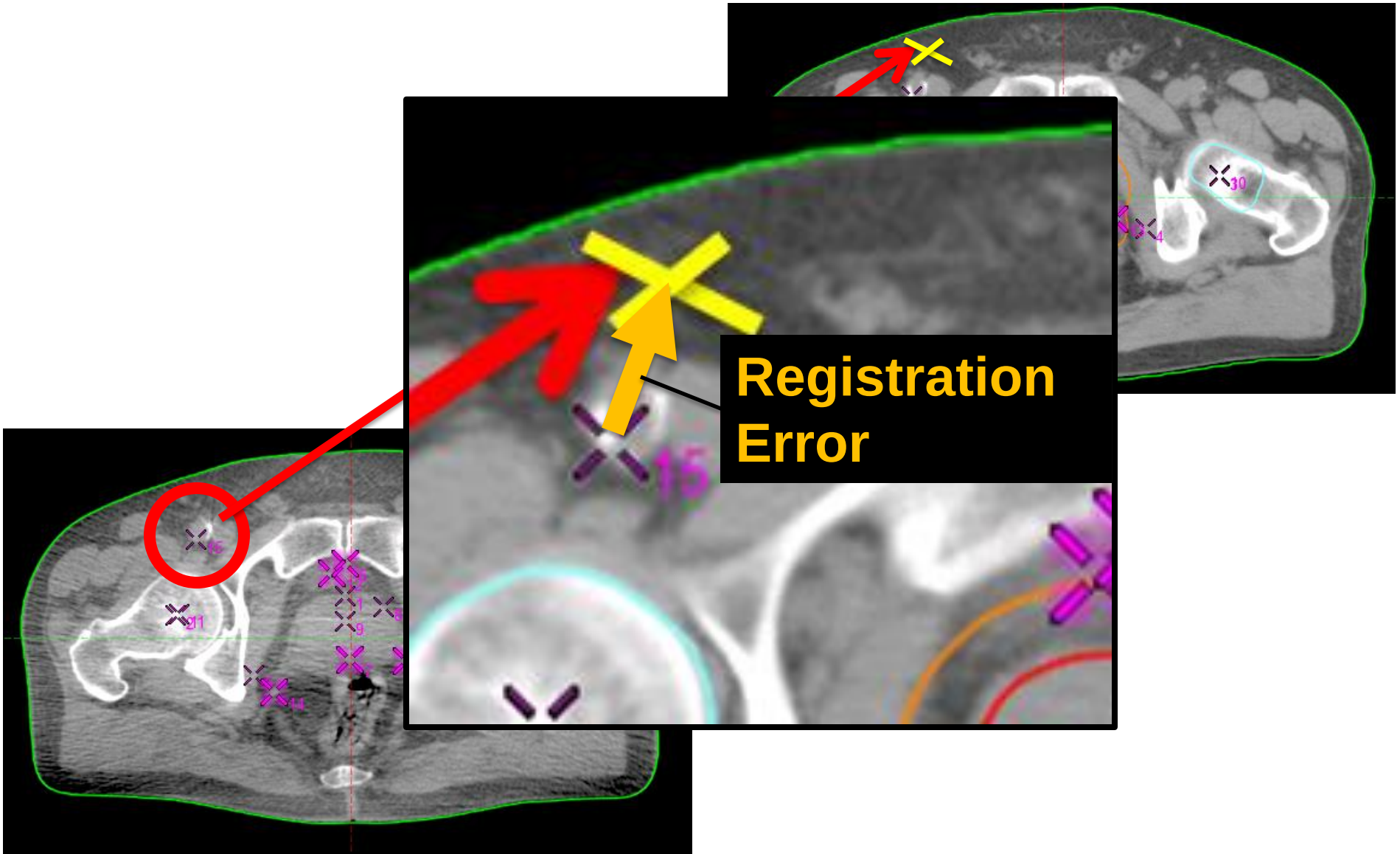
Target Registration Error



Exercise 6 – Code Exploration

1. Open Windows Explorer.
2. Navigate to
3. C:\variandeveloper\Developer Workshop 2.0\exercise 6\SmartAdapt Scripting API\Projects\TRE
4. Double click TRE.SLN to open Visual Studio project.
5. Review the code.

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