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# Automation with Velocity™
**Intelligent Automation for Treatment Planning Workflows**

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**Product Manager**

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# Automation

**1. DICOM Automation**

**2. Structure Scripting**

**3. ACTOR & ACTIVE dosimetry**

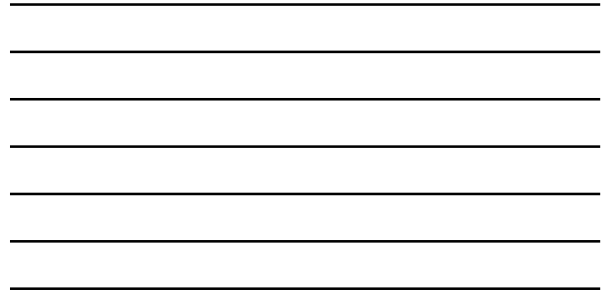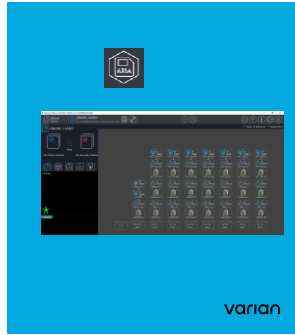**4. Developer Mode API**

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DICOM Automation

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## ARIA™ Sync
### & Save to ARIA

- Velocity system automatically synchronizes imaging from ARIA
- One-click "Save to ARIA" saves back to ARIA
- Saves all data viewed, and any related information
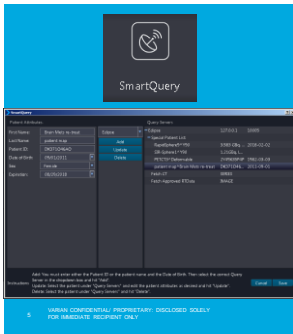- Configurable for Eclipse-only sites as well



## SmartQuery
### PACS automation

- Add patients to PACS-specific "watchlist"
- Recent patients are added by default
- Automatically pull new imaging for patients
- Configurable and customizable for specific requirements and workflows



## DICOM triggers
### Query and Import

- Set up actions for automatic behavior based on DICOM query results and/or import
- Scriptable to include pulling related objects, creating body contours, pushing data
- Allows sending messages to users as notifications
- XML for configuration

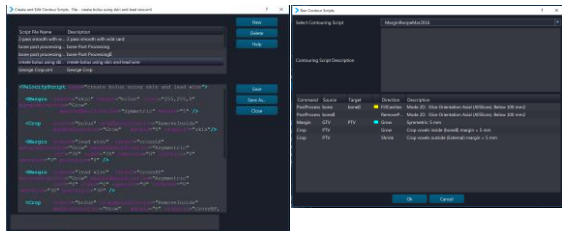# Structure Scripting
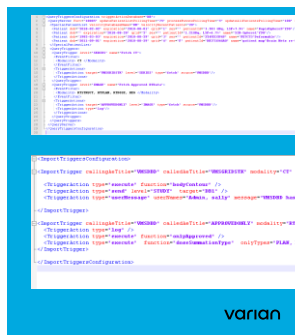
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## Contour Scripting
**Automation for structure operations**

• XML Scripting language

• Margins

• Boolean

• Smoothing

• Post-Processing (hole removal, extraction, etc)

• Set or change colors and names

• Create, delete, edit

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## Edit and Validate
**Import, Export, Validate, and View**

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## ACTOR **&** ACTIVE Dosimetry
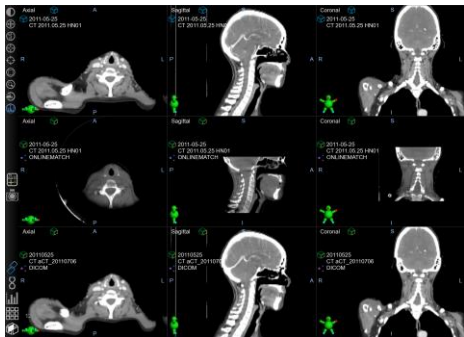
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## Adaptive Calculation and Tracking
### Navigators for use with Eclipse and ARIA

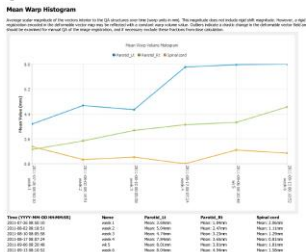| ACTOR:<br>Commissioning | ACTOR:<br>Plan Generation | ACTIVE Dosimetry:<br>Accumulation |
|---|---|---|
| • Used for commissioning of the system<br><br>• Verifies that system reproduces original dose for original plan<br><br>• Aids in setup of electron density curves, dose calculation models, etc. | • Bulk deformable for online-imaging<br><br>• Creates "adaptive CTs" for dose calculation<br><br>• Copies RT-Plans onto adaptive CTs and pushes into Eclipse<br><br>• Reports structure changes over time & Deformable QA | • Accumulates delivered doses<br><br>• Compares plan *vs* delivered DVH metrics<br><br>• Creates subtraction dose volume for hot/cold analysis |

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### AdaptiveCT
**Planning CT Hounsfield units with treatment anatomy**

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## ACTIVE Dosimetry
**Compare Plan to Delivered dose**

- Accumulates daily doses using inverse deformable registration

- Set pass/fail criteria for dose volume histogram metrics

- Create hot/cold structures for re-planning

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# Deformable QA review

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**Lists UIDs, Patient information, timestamp, etc**



## Isocenter shifts based on ONLINEMATCH



## Structure Volume Changes

## Negative Jacobian Determinants (flips)



## "Are your bones rigid?" – Elasticity of high-HU



## Volume Change consistency

## Scalar Magnitude of Deformation Vectors (raw data)



## Min/Max of Scalar Magnitude of Deformation Vectors
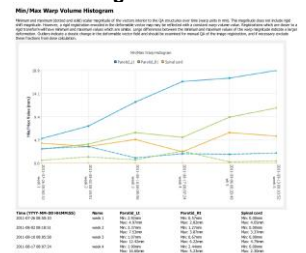


## Box/Whiskers of Jacobian Determinants (natural log)
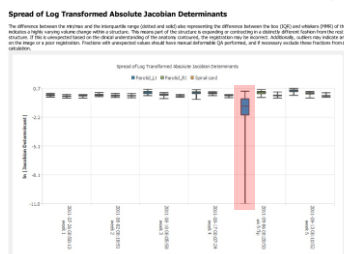
## MMR and IQR of ln(abs(J))



## Raw Data



# Developer Mode API

# Architecture
## API + VelocityEngine
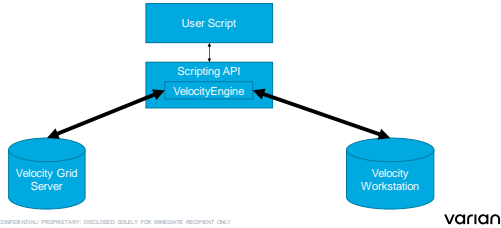


# Languages Supported
## VelocityEngine packages

- **C#**
  - .NET assembly
    - .NET 4.0
    - x64 architecture

- **Python**
  - Python 2.7
  - CPython interpreter (standard)
  - Installable as Python wheel

```
static void Main(string[] args) {
    var engine = new VelocityEngine();
    engine.loginToGrid(USER, PASS, GRID_IP, GRID_PORT, GRID_DB);
    engine.loadPatient(PATIENT_ID);
```

```
import velocity
engine = velocity.VelocityEngine()
engine.loginToGrid(DB_USER, DB_PASS, DB_IP, DB_PORT, DB_NAME)
engine.loadPatient(PATIENT_ID)
```

# Developer Mode
## API details & Restrictions

- Works with Velocity 4
- Initial release is non-clinical
  - Requires Developer Mode license
- "Script" user type
  - Each login consumes a license, released on log out
  - Workstation is single-login
  - Grid allows multiple script logins with a single user
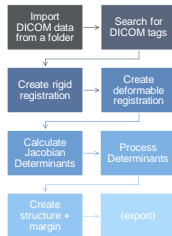
## How to use API
**Uses of Developer Mode**

- **Automate** – take a manual task and automate it for bulk processing, e.g. deformable registration / quality assurance

- **Replace** – replace the Velocity client application with your own custom software

- **Leverage** – take advantage of utility functions for working with DICOM data and registration objects

- **Patient Transfer** – export DICOM data to Eclipse, or transfer patients to a clinical Velocity database

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## Example Script
**Deformable QA structure "highlighting" areas of uncertainty**

**Use case**:
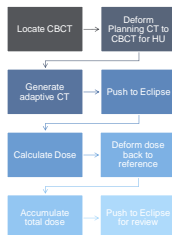Automate deformable and create structures for review



Import DICOM data from a folder → Search for DICOM tags

Create rigid registration → Create deformable registration

Calculate Jacobian Determinants → Process Determinants

Create structure + margin → (export)

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## Example Script
**Patient specific "adaptive" QA of delivered dose**

**Use case**:
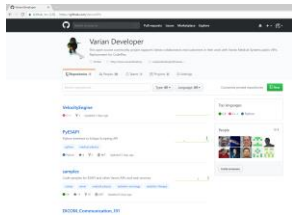Automatically calculate dose for CBCT imaging based on treatment shifts



Locate CBCT → Deform Planning CT to CBCT for HU

Generate adaptive CT → Push to Eclipse

Calculate Dose → Deform dose back to reference

Accumulate total dose → Push to Eclipse for review

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**VarianDeveloper GitHub**
Free download

VelocityEngine

github.com/VarianAPIs

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( Thank You )

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