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https://github.com/ kaspermarstal/ SimpleElastix

# SimpleElastix: A user-friendly, multi-lingual library for medical image registration

### Introduction

In the past decade a significant amount of research has focused on developing new registration algorithms. However, less research has focused on accessibility, interoperability and extensibility of such algorithms and their implementations. This is a problem since image registration is a prerequisite for a wide range of medical image analysis tasks and a key algorithmic component for image-based studies.

### What is SimpleElastix?

SimpleElastix extends the SimpleITK image processing library by including the elastix image registration toolbox. Elastix is a modular collection of high-performance medical image registration algorithms. With SimpleElastix, all of elastix' funcitonality becomes available many programming languages, making elastix easy to use in any of the following envrionments:

SimpleITK	
Facade Interface	

Open source, user-friendly implementations of scientific software make state-of-the-art methods accessible to a wider audience, promote opportunities for scientific advancement, and support the fundamental scientific principle of reproducibility. To this end, we have developed the SimpleElastix software package.

### **Take-home messages**

- Incorporate elastix and transformix in your image processing pipeline with few lines of code.
- Download at <u>https://github.com/kaspermarstal/</u> SimpleElastix.
- Documentation available at <u>https://simpleelastix.readthedocs.io</u>.
- Project website at <u>https://simpleelastix.github.io</u>

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SimpleElastix supports C++, C#, Python, R, Java, TCL, Ruby, Octave and Lua on Linux, Mac and Windows.

### ITK Filter Interface

### Elastix Core

Figure 1. Schematic depiction of software architecture. An ITK Filter-style wrapper and a SimpleITK-style facade interface connects elastix with the SimpleITK buildinfrastructure, allowing SimpleITK to be compiled with support for elastix and transformix.



Figure 2. Example of two registered images from the Hammersmith83 dataset using the Python code below. Checkerboard pattern of fixed and result images (left) and overlay of associated segmentations (right).

# Examples: Image registration in Python, R and Java

### **Protyping in Python**

### import SimpleITK as sitk

fixedImage = sitk.ReadImage('fixed.nii')
movingImage = sitk.ReadImage('moving.nii')
resultImage = sitk.Elastix(fixedImage, movingImage)

## **Prototyping in R**

### library(SimpleITK)

fixedImage <- ReadImage('fixed.nii', 'sitkFloat32')
movingImage <- ReadImage('moving.nii', 'sitkFloat32')
resultImage <- Elastix(fixedImage, movingImage)</pre>

### Parallel processing with Java 8 parallel streams import org.itk.simple.\*

Image fixedImage = ReadImage("fixed.nii")
List<Image> movingImageFileNames
 = Arrays.asList("moving0.nii", "moving1.nii")
movingImages.parallelStream.forEach(
 movingImageFileName ->
 Elastix(fixedImage, ReadImage(movingImageFileName))

