ITK Version 4 Registration Framework

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Abstract

The ITKv4 registration framework is a unified system for performing multi-threaded affine and deformable image registration. The revised framework supports composite transformations, unbiased registration, the simultaneous use of multiple similarity metrics, multi-channel/tensor image registration and geometrically correct transformation of covariant vectors and tensors via the composite transform framework and transformations based on finite element models. ITKv4 also contains new metrics that can be used for registering point sets, curves and surfaces as well as a set of efficiently implemented neighborhood correlation metrics. Despite these significant additions, the user interface to the framework is, at the basic level, unchanged from prior versions of ITK. Furthermore, we provide new optimization strategies that simplify the user experience by reducing the number of parameters that need to be set by the user.

1 Introduction

2 Nomenclature

A position: $\mathbf{x} \in \Omega$ where Ω is the domain.

An image: $I \colon \Omega^d \rightarrow \mathbb{R}^n$ where n is the number of components per pixel and d is dimensionality.

Domain map: $\phi \colon \Omega \rightarrow \Omega$ where $\rightarrow$ may be replaced with any mapping symbol below.

Affine mapping: $\rightarrow$

Deformation field: $\rightsquigarrow$ deformation field mapping J to I.

Diffeomorphic mapping: $\leftrightsquigarrow$

Composite mapping: $\phi = \phi_1(\phi_2(\mathbf{x}))$ is defined by $\leftrightsquigarrow\rightarrow$ where ϕ_2 is of type $\leftrightsquigarrow$ which precedes the application of $\rightarrow$.