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Here is an **exhaustive list of possible parameters** for a ParameterMap in SimpleElastix, along with their possible values. These parameters define the registration process and can be customized for specific use cases.

**General Parameters**

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Possible Values** | **Description** |
| Registration | "MultiResolutionRegistration", "SingleResolutionRegistration" | Defines the registration method. |
| Transform | "TranslationTransform", "EulerTransform", "AffineTransform", "BSplineTransform" | Specifies the type of transformation applied. |
| NumberOfResolutions | Integer (e.g., 4) | Number of resolution levels in the multi-resolution pyramid. |
| AutomaticParameterEstimation | "true", "false" | Automatically estimates optimizer parameters. |
| FixedImagePyramid | "FixedSmoothingImagePyramid", "FixedRecursiveImagePyramid" | Specifies how the fixed image is downsampled for multi-resolution registration. |
| MovingImagePyramid | "MovingSmoothingImagePyramid", "MovingRecursiveImagePyramid" | Specifies how the moving image is downsampled for multi-resolution registration. |
| WriteResultImage | "true", "false" | Whether to write the resulting registered image to disk. |

**Metric Parameters**

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| --- | --- | --- |
| **Parameter** | **Possible Values** | **Description** |
| Metric | "AdvancedMattesMutualInformation", "AdvancedMeanSquares", "AdvancedNormalizedCorrelation", | Similarity metric used to evaluate alignment between images. |
|  | "NormalizedMutualInformation", "AdvancedKappaStatistic" |  |
| NumberOfHistogramBins | Integer (e.g., 32) | Number of histogram bins for mutual information metrics. |
| NumberOfSpatialSamples | Integer (e.g., 4096) | Number of spatial samples used for metric computation. |
| NewSamplesEveryIteration | "true", "false" | Whether to use new samples at every iteration to avoid overfitting. |

**Optimizer Parameters**

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| --- | --- | --- |
| **Parameter** | **Possible Values** | **Description** |
| Optimizer | "AdaptiveStochasticGradientDescent", "RegularStepGradientDescent", "ConjugateGradient" | Optimizer used to minimize the similarity metric. |
| MaximumNumberOfIterations | Integer (e.g., 500) | Maximum iterations per resolution level. |
| MaximumStepLength | Float (e.g., 1.0) | Initial step size for gradient descent optimizers. |
| SP\_a | Float (e.g., 0.1) | Controls step size adaptation in stochastic gradient descent optimizers. |

**Transform-Specific Parameters**

**For B-spline Transform**

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Possible Values** | **Description** |
| FinalGridSpacingInPhysicalUnits | Float (e.g., 10.0) | Spacing of the final B-spline grid in physical units (mm). |
| GridSpacingSchedule | List of Floats (e.g., [4.0, 2.0, 1.0]) | Multi-resolution grid spacing schedule for B-spline transform. |

**For Affine Transform**

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| **Parameter** | **Possible Values** | **Description** |
| AutomaticScalesEstimation | "true", "false" | Automatically scales affine transform parameters based on image size and spacing. |

**Sampling Parameters**

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| --- | --- | --- |
| **Parameter** | **Possible Values** | **Description** |
| SampleGridSpacingInVoxels | Integer (e.g., 5) | Spacing between sampling points in voxels for metric computation. |

**Interpolator Parameters**

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| **Parameter** | **Possible Values** | **Description** |
| Interpolator | "LinearInterpolator", "NearestNeighborInterpolator", "BSplineInterpolator" | Interpolation method used during resampling of images. |

**Example: Full Parameter Map**

Here’s an example of a full parameter map for a multi-resolution B-spline registration:

param\_map = sitk.GetDefaultParameterMap("bspline")  
param\_map["Registration"] = ["MultiResolutionRegistration"]  
param\_map["Transform"] = ["BSplineTransform"]  
param\_map["NumberOfResolutions"] = ["4"]  
param\_map["Metric"] = ["AdvancedMattesMutualInformation"]  
param\_map["NumberOfHistogramBins"] = ["32"]  
param\_map["Optimizer"] = ["AdaptiveStochasticGradientDescent"]  
param\_map["MaximumNumberOfIterations"] = ["2000"]  
param\_map["FinalGridSpacingInPhysicalUnits"] = ["8.0"]

To explore all possible parameters programmatically:

default\_map = sitk.GetDefaultParameterMap("affine")  
for key, value in default\_map.items():  
 print(f"{key}: {value}")

This will give you an exhaustive list of all keys and their default values for a specific transform type (affine, bspline, etc.).

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