WHY CHOOSE MIRADA REGISTRATION?

White Paper

MIRADA
The Imaging Software People

Why Choose Mirada Registration?

In 2002, Mirada introduced Fusion7D, the industry's first clinical Deformable Image Registration product. Since then, its algorithms have been deployed in thousands of systems worldwide either integrated within its own or within OEM products. At various times, Mirada registration has been integrated into products sold by Varian, GE, Siemens, Toshiba, Vital Images, Carestream, Sectra, and others. Such extensive clinical deployment, rigorous testing and over a decade of continuous development have resulted in a best-in-class technology.

Mirada DIR for all patients, modalities, and workflows

Mirada RTx provides two classes of DIR algorithm: Mirada CT Deformable, a highly optimized derivative of Lucas-Kanade Optic Flow [3], and Mirada Multi-modal Deformable, a proprietary form of Mutual Information [2,4,5]. This results in the most comprehensive commercial DIR engine available, suitable for all patients, modalities, and workflows. In contrast, other vendors provide either mono-modal DIR algorithms such as Demons [1], which is applicable to (KV) CT modalities only and is highly sensitive to image artifacts, or multi-modal DIR such as B-Spline [2] which typically requires a user-defined ROI to produce reasonable results and is often outperformed by CT deformable algorithms in contour transfer tasks.

Workflow Optimized DIR

Critically, Mirada breaks with the "one-size fits all" approach to DIR adopted by other vendors and supplies algorithms that are optimized for particular tasks. Mirada Medical scientists carefully tune internal parameters such as deformation field smoothness, degrees of freedom, and similarity function sensitivity to optimize performance for particular clinical tasks. Mirada RTx automatically selects the optimal algorithm and internal parameters based on the workflow and loaded modalities. For example, Mirada atlas-based contouring utilizes Mirada's CT deformable algorithm optimized to handle large deformations, whereas MRI to planning CT fusion is supported by a Mirada's multi-modal algorithm constrained to provide a robust mapping between the CT and MRI of the same patient.

	Atlas - contouring	Contour warping	Robust to image artifacts	Dose warping and summation	CT-MRI	MV and all types of vendor CBCT	Operates without ROI
Mirada	✓	✓	✓	✓	✓	✓	✓
Demons	✓	✓					
B-Splines			✓	✓	✓	✓	

Choosing between Demons and B-Spline is a compromise. Mirada RTx is the only clinical Deformable Image Registration solution that provides reliable results for all patients, modalities, and workflows.

Mirada DIR Algorithms

Mirada's CT DIR algorithm is a highly optimized derivative of Lucas-Kanade Optic Flow [3]. The transformation model is free-form but is regularized to produce continuous, biologically plausible, deformation fields. It is accurate, can handle large deformations and is very fast but, critically, is highly robust to image artifacts unlike Demons [1]. Therefore it is suitable for atlas-based contouring, contour warping, and dose warping and summation. Mirada's multi-modal DIR algorithm optimizes a Mutual Information based similarity function [2,4,5] over a Radial Basis Function (RBF) transformation model. It is used for CT-MR, CT-PET, CT-contrast CT and CT-CBCT applications within Mirada RTx. It is accurate and faster than B-Spline based methods due to its fewer degrees of freedom and provides smooth and biologically plausible deformation fields. It can handle KV and MV cone beam images from all major manufacturers and in most cases it works without the need for a user-defined ROI, thereby saving time, avoiding user error and inter-operator variability. It has been validated for use with common clinical tasks and licensed to leading healthcare companies including Varian Medical Systems.

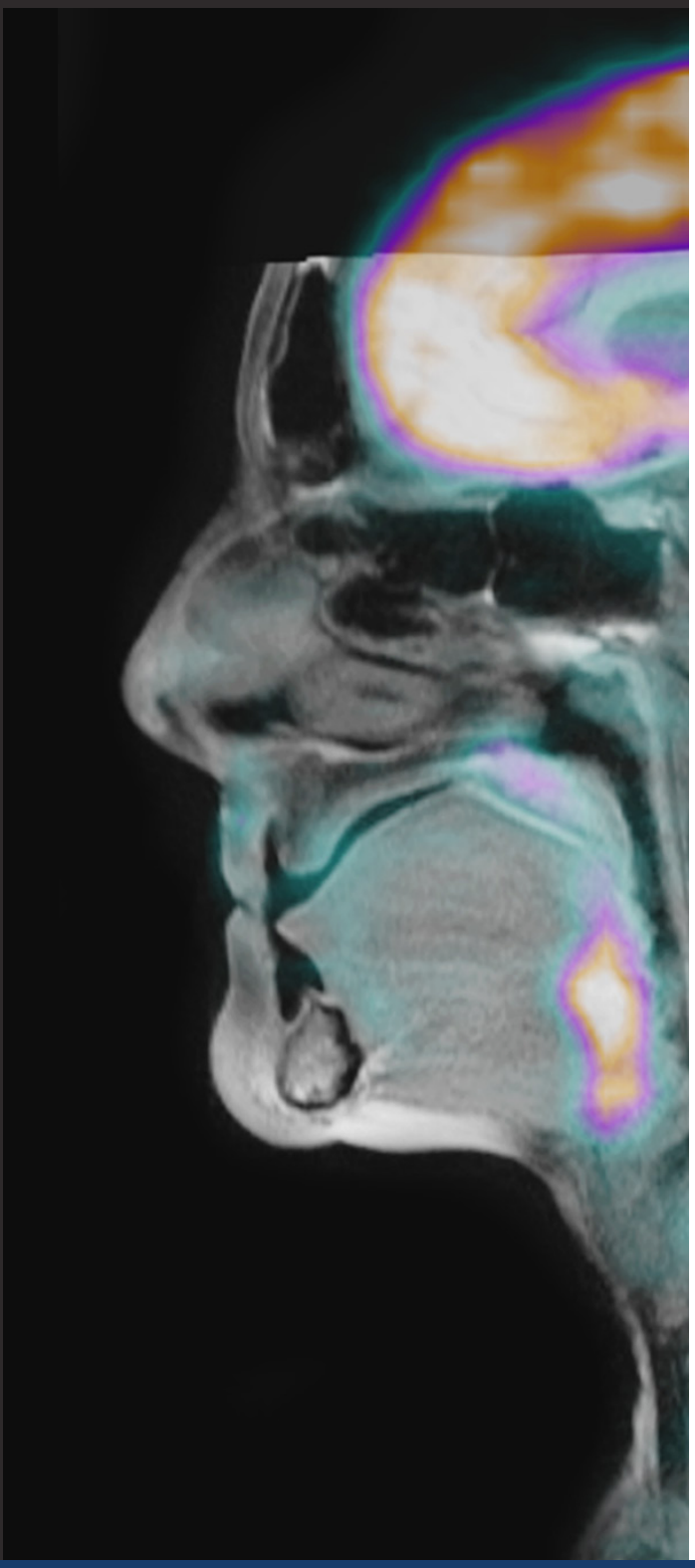
Other DIR techniques

B-Spline DIR

B-Spline [2] is a multi-modal DIR algorithm which optimizes a global similarity measure, such as Mutual Information, and represents the deformation field as a parameterized B-Spline. B-Spline is good at registering different modalities, is robust to intensity differences, imaging artifacts and can be tuned to provide smooth deformation fields. This makes this algorithm appropriate for multi-modal fusion and dose warping. However, the method is very slow and hence is typically not run to convergence. Therefore, in practice the user is required to carefully place an ROI to achieve acceptable results in reasonable time. This is time consuming and can result in inter-user variability. Moreover, B-Spline DIR tends to be out-performed by other methods in contour transfer applications such as atlas-based contouring both in terms of speed and accuracy.

Demons DIR

Demons [1] is a mono-modal DIR algorithm which uses a local similarity measure based on intensity difference. Its advantages are that it is fast and works well in applications where the image intensities are very similar. Demons performs well in contour transfer tasks such as atlas-based contouring and replanning for structures with well contrasted edges. However, Demons can be highly sensitive to the presence of image artifacts such as those arising from metal implants and dental fillings. Moreover, it cannot be used with uncorrected cone beam images, in the presence of variable amounts of contrast, or with MRI. Finally, Demons can produce biologically implausible deformations away from high contrast edges, e.g. inside the liver and brain, rendering dose transfers and composites unreliable.



About **Mirada**

Mirada Medical develops medical imaging software applications that provide simple and accessible solutions to complex image analysis problems in the diagnosis and treatment of cancer and other diseases. Through automation, our products improve consistency and productivity while enabling clinicians to deliver more personalized care. By combining deep learning technology with our thorough understanding of the challenges faced in oncology today, Mirada is leading the development of next generation imaging software and decision support products. Our staff are passionate about using their expertise to help our customers provide better healthcare for more patients.

References

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mirada-medical.com

Worldwide Headquarters

Mirada Medical Ltd.
Oxford Centre for Innovation
New Road, Oxford, OX1 1BY
United Kingdom

info@mirada-medical.com
+44 (0)1865 261410

USA Office

Mirada Medical USA, Inc.
999 18th Street, 2230S
Denver, CO 80202
USA

info@mirada-medical.com
877.872.2617