# Pymedix

## Af Autofuse

Autofuse is the first and only fully automatic 3D deformable image registration (DIR) software. Built from the ground up, Autofuse is a quick, powerful, and reliable image correlation and data fusion tool for radiation planning that challenges the status guo of image registration software.



#### Machine Perception as the Foundation for Machine Learning

Human Learning Subjective, experience-driven predictions or decisions

Human Perception Subjective, time-consuming case-by-case interpretation

Human Experience Accumulated over a lifetime

Insight

Achieve accurate and deep understanding of the underlying processes in the data

> Machine Learning Build statistics-driven models to make data-driven predictions or decisions

#### Machine Perception

Large-scale interpretation of data in a manner similar to the way humans use their senses to relate to the world around them

#### **BIG** Data

>95% of all digital medical data is imaging. Total US EHR data is estimated at 600PB-10EB

Human Cognition

True Al

Real clinical images



Radiation therapy planning scan



Leading competitor's automatic registration

#### Intractable?

Deformable image registration has long been viewed as a mathematically intractable problem, yet humans perform this task with ease. Currently available methods rely upon a local region search for correspondences, severely limiting the robustness of the result and usefulness to a handful of specific scenarios. Despite the rapid development and adoption of neural network-based machine learning approaches for other domains, progress has been slow in automating this labor-intensive task because of difficulty ensuring a reasonable starting spatial correspondence.

#### Inspired by human visual processing



#### Taking vision into the 3rd dimension

Decades of neuroscience research have shown that the visual cortex of the brain abstracts and reduces visual data for higher processing. Autofuse piggybacks on this very successful architecture and extends the concepts from 2D vision into 3D in order to focus computing effort on the areas of the image that matter. This make some tasks, such as global image search, which is generally considered intractable, not just a possibility, but something computationally efficient.

### Outperforms other technology

In challenging clinical cases like the example below, Autofuse generates superior results, even without the advantage of initial manual rigid registration. Through advanced internal consistency checks, Autofuse uniquely recognizes the presence or absence of image contents, ensuring high confidence results without any user input or guidance.



#### Autofuse works, with >99.999% probability

Autofuse works with overwhelming probability. Only 3 correct matches are needed to obtain a rigid registration. According to binomial statistics, the chance of Autofuse getting at least 3 matches is 99.999%, even under the most adverse conditions. Autofuse can achieve good deformable registrations in the general case, not specific scenarios, with very high probabilities.

Real clinical images







Radiation therapy

planning scan



Af Autofuse

#### Quantitatively superior

Autofuse is the first and only DIR product to have computationally efficient global feature search, eliminating the need for initial rigid registration and making it immune to differences in orientation, translation, and variations in intensity with 99.999% probability. This unmatched robustness translates to significantly lower displacement errors (p < 0.00001) in a comparison against leading competitors using publicly available 4DCT datasets.

#### Visibly better

In addition to quantitatively superior benchmarks, Autofuse's robustness translates into visibly better registration results. In a blinded 3-way comparison, Autofuse was judged superior in 75% of cases by the majority of radiation oncologists at a major university medical center.



#### Automatic tuning, patient-specific QA

Because Autofuse uses discrete features, it can estimate confidence in the registration result, even without knowledge of the ground truth. Autofuse uses this information to automatically tune its hybrid algorithm for the registration case at hand to achieve unprecedented robustness. In the near future, Autofuse will produce a full spatial confidence maps for patient-specific QA.

#### Autofuse vs. leading competitor Mean registration error



#### Transparent. Nothing to hide

The Autofuse interface is designed to provide users a transparent look at the DIR process. See the entire process of feature detection, matching, elimination of errors, and the final DIR result, in real time, from beginning to end.



Assess registration confidence



#### Streamline workflow. Increase productivity

Autofuse easily integrates with and streamlines the radiotherapy workflow. It is a sophisticated and efficient way to work with the large amounts of data from multiple image sets. Eliminating the need for manual intervention, our technology improves accuracy, consistency, and saves time — increasing the efficiency and throughput of your practice.

Autofuse is estimated to reduce deformable registration time by 50%, and even more for difficult cases, leading to an increase in overall productivity of 10%.

#### Traditional image registration workflow

#### For doctors, dosimetrists, and physicists

Inspired by the human visual system, our technology can process unprecedented volumes of 3D imaging data and produce registration results with high clinical confidence by leveraging the digital consistency and precision of machine perception, while achieving human-like robustness and autonomy.

Doctors, with improved visualization and clinical confidence, can better tailor their treatments, potentially reducing treatment toxicity. For patients, the enhanced ability to fuse data from diagnostic scans can mean eliminating unnecessarily repeated scans, reducing radiation exposure from imaging, and saving time.



#### What users see with Autofuse



#### Innovating cancer treatment

Pymedix is building fully automated machine perception technologies that move the radiotherapy experience forward. With never-before-seen accuracy and speed, our 3D deformable image registration software, Autofuse, makes better, more personalized cancer treatment possible.

We have the cross-disciplinary expertise needed to translate ideas from different fields, to combine them in innovative ways, and to implement solutions that bridge the gaps between research, engineering, and medicine. Our technology will keep radiotherapy at the forefront of personalized medicine and big data while making planning workflow as intelligent and efficient as possible for physicians, dosimetrists, and physicists. Pymedix, Inc. 707 Skokie Blvd Suite 600 Northbrook, IL 60062

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