ITEA 4

Project Results

ASSIST

Control for clinicians in image-guided therapy

Through innovations in areas like artificial intelligence, 3D visualisation and robotic assistance, the ITEA project ASSIST (Automation, Surgery Support and Intuitive 3D visualisation to optimise workflow in IGT SysTems) gives control to clinicians and simplifies clinical workflows during image-guided therapy.

Image-guided therapy plays a key role in healthcare quality and personalisation, utilising multiple imaging modalities for diagnosis and treatment guidance during minimally-invasive surgery. Although designed to streamline processes, this technology often adds complexity: clinicians frequently struggle with the large volume of data acquired and the difficulty in deriving meaningful insights. This information overload and extensive manual interaction can lead to fatigue, increasing the risk of serious medical errors and overlooked abnormalities.

To simplify clinical workflow during image-guided therapy procedures, ASSIST has developed and integrated AI-based solutions for precision diagnosis, personalised treatment, intuitive 3D visualisations and robotic-assisted interventions. The aim is to bring the clinician back in control of the clinical procedure, which has been demonstrated in five well-integrated use-cases: intracranial haemorrhage, brain tumours, lung diseases, hepato-pancreato-biliary oncology and prostate enlargement. End-users have also been involved at all stages to help ensure swift clinical uptake.

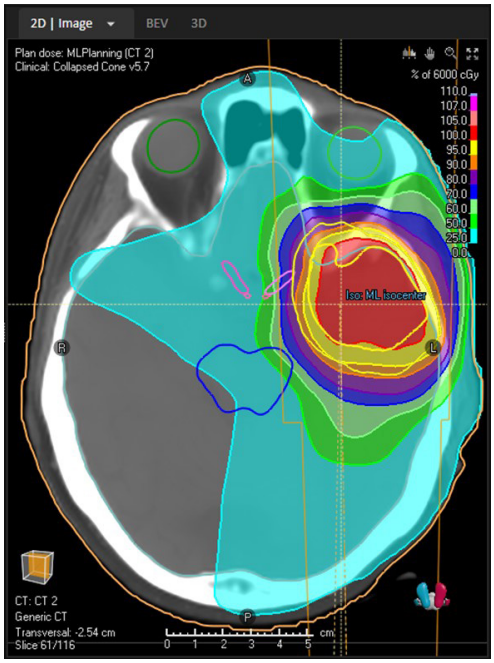
Technology applied

ASSIST's solution concept begins with imaging modalities such as X-ray, CT, MRI and combinations thereof. Large amounts of imaging data are generated during diagnosis and treatment, which are needed to train algorithms to interpret image content automatically, segment images and suggest the location of nodules or lesions. However, health data is often siloed. To enable the training of AI-based applications, ASSIST therefore investigated synthetic data generation and federated learning to enrich the datasets collected. Once data collection and training processes are in place, algorithms are trained for diagnosis and treatment across the use-cases. For precision diagnosis and personal treatment plans, the algorithms improve image segmentation accuracy and expedite workflows by reducing the need for manual annotation or segmentation.

Beyond image interpretation, the focus lies in user-facing elements like 3D visualisation, augmented reality (AR), virtual reality (VR) and robotic assistance. Most notably, the visualisation component employs a stereoscopic display that uses eye-tracking instead of glasses to allow users to perceive depth within the 3D data acquired. Alongside this, models have been developed for quality perception parameters to better address user experience. Finally, robotic assistance supports clinicians during minimally-invasive procedures, such as needle insertion or tumour targeting. This includes a set-up that uses imaging data to plan and execute device placement while modelling and compensating for patient motion. Haptic feedback has also been developed using robotic manipulation to enable the physician to 'feel' such interactions, even when working remotely.

Making the difference

First and foremost, ASSIST offers improved task automation and ease of use, shorter procedure times, and improved clinical performance in terms of segmentation, accuracy and reproducibility – all of which translate into greater confidence for clinical users. The degree of accuracy differs per use-case, but strong results have been seen across the project: liver tumour segmentation using deep learning techniques, for instance, is on track for a 20% increase in accuracy, while automated segmental airway labelling has risen from 78% accuracy to more than 90%. As for procedure times, ASSIST has demonstrated that federated training of segmentation and dose prediction models for radiotherapy treatment planning is feasible with data from clinical workflows, reducing the time taken from



Example image of the ASSIST brain oncology use case, demonstrating automated image segmentation and radiotherapy planning

3-4 manual hours to 15 automated minutes.

Although ASSIST focused primarily on clinicians, its results have major benefits at both the patient and hospital level. Enhanced accuracy in tumour segmentation, for example, allows as much healthy tissue to be preserved as possible, leading to fewer side-effects for patients. Meanwhile, the project has demonstrated the value of federated learning by showing that combined insights from various sites leads to enhanced algorithm performance compared to any single site. Each hospital can thus benefit from a broader dataset without sharing sensitive data as only network parameters are exchanged and re-employed at each site.

The future

The next step is to bring such benefits to the clinic, for which ASSIST has already taken impressive strides thanks to the involvement of a comprehensive value chain. For instance, Linköping University developed federated learning and synthetic image generation strategies to enrich data and improve algorithm development, which have already been utilised by industrial partners to deliver clinical applications. One example is RaySearch, which has integrated new and upgraded deep learning models into their commercial treatment planning system RayStation – with a customer base of over 1000 cancer clinics worldwide. New products are also on the horizon: Philips has worked on an open innovation platform for co-creation with customers and third-party integration and has started a clinical trial at Radboud UMC Hospital to validate an improved workflow for lung oncology, while Barco will soon commercialise a 3D display with a switchable lens and better tracking to expand their market leadership towards 3D medical displays for healthcare applications. This is just a small sample of ASSIST's wide-reaching exploitation and dissemination activities, which – alongside further collaboration outside of the ITEA framework – anticipates a major impact on the experience of image-guided therapy for both patient and practitioner.

Major project outcomes

Dissemination

- 25 publications and 39 presentations at conferences/fairs

Exploitation (so far)

New products:

- 3D stereoscopic display: allows 2D and 3D workflows along the entire imaging chain
- LungQ v3.0.0: lung airway segmentation application, certified as class IIb medical device
- iFusion: Federated ML application for training and monitoring of machine learning models
- RayStation: deep learning-based application for medical image segmentation and dose prediction of radiation therapy treatment
- SAINT platform: MRI-only radiotherapy treatment planning, allowing also 3rd party integration

New services:

- Open Innovation Platform for co-creation with customers and integration with 3rd parties
- Training module and simulator for liver ablation procedures
- Federated Learning platform that allows organisations to train AI models on distributed datasets without compromising data privacy

New systems:

- Deep Learning based intracranial haemorrhage (ICH) detection and classification system

Standardisation

- Participation in relevant IEC and ISO committees, e.g. IEC 62 Software Network and Artificial Intelligence Advisory Group
- Participation in DICOM working group and AAPM Task Group 196 on colour calibration
- Preparing for participation in Khronos group on OpenXR
- Contribution to standard-of-care use of 3D visualisation methods in liver tumor resection planning

ITEA is the Eureka RD&I Cluster on software innovation, enabling a large international community of large industry, SMEs, start-ups, academia and customer organisations, to collaborate in funded projects that turn innovative ideas into new businesses, jobs, economic growth and benefits for society. ITEA is part of the Eureka Clusters Programme (ECP).

https://itea4.org

ASSIST

20044

Partners

Belgium

- Barco
- Lifelike

Sweden

- Eigenvision
- Inovia AI
- Linköping University
- RaySearch Laboratories
- Scaleoutsystems
- Spectronic

The Netherlands

- Leiden University Medical Center
- Philips Medical Systems Nederland
- Quantib
- Thirona
- University of Twente

Türkiye

- ForteArGe Informatics, Engineering Consultancy
- GCA Yazilim
- Innova

Project start

October 2021

Project end

September 2024

Project leader

Robert Hofsink, Philips

Project email

robert.hofsink@philips.com

Project website

https://itea4.org/project/assist.html