Computed Tomography

White paper

AI to save time and improve precision in CT patient positioning

Precise Position

Background

Philips Precise Position is a novel Philips approach that uses Artificial Intelligence (AI)* to help quickly and precisely position patients for successful CT exams. The AI-enabled camera used sophisticated convolutional neural network technology for technology that adapts to the patient.

Patient miscentering is a common and documented challenge in CT imaging that can lead to unwanted consequences such as increased radiation dose to the patient and image noise.[1-3] In addition, research among radiology technologists and imaging directors in the US, France, Germany and the UK revealed that they believe that 23% of their work is inefficient. Respondents stated that automating processes, including patient positioning, would go far toward helping imaging staff spend less time setting up the scan, and more time with patients. Radiology technologists and imaging directors felt that combined technology factors (equipment quality and capability, mastery of the technology, and ease of use of imaging equipment) are the second-highest contributors overall (36%) in not achieving a first-time-right image. Focusing innovation efforts in these areas has great potential to improve workflow and throughput, enhance patient satisfaction, and decrease staff stress and burnout.[4]

Precise Suite

Precise Position is one of the many tools of Philips Precise Suite, which includes AI that is deeply embedded into tools clinicians use every day to be able to apply their expertise to the patient, not the process.

Figure 1 Precise Position features a ceiling-mounted AI-enabled camera.

Precise Position delivers intelligence that **adapts to you**

Philips Precise Position uses innovative AI-based algorithms to deliver intelligence that adapts to the patient, resulting in more efficient workflow, an improvement in operator consistency and most importantly, additional time to focus on the needs of the patient to increase the likelihood of a successful exam. The Precise Position AI-enabled camera is mounted in the ceiling above the patient table **(Figure 1).** Once the patient is on the table, the camera uses sophisticated convolutional neural network technology, as well as color and depth functions, to identify 13 points of patient anatomy for positioning **(Figure 2)**. The patient orientation in prone or supine position, and head-first or feet-first position, is automatically selected with no need for additional manual adjustment in 99% of cases, instantly automating an otherwise manual process, delivering ease of use of the CT equipment, and providing a 23% reduction in patient positioning time. Precise Position then calculates optimal table height for vertical iso-centering and automatically displays the surview start and end positions, both at the CT console and the patient-side OnPlan gantry control **(Figure 3)** with no need for additional manual adjustment in 93% of cases. The data is then transferred to the system's smart load feature and the table is moved to the surview start position **(Figure 4)**.

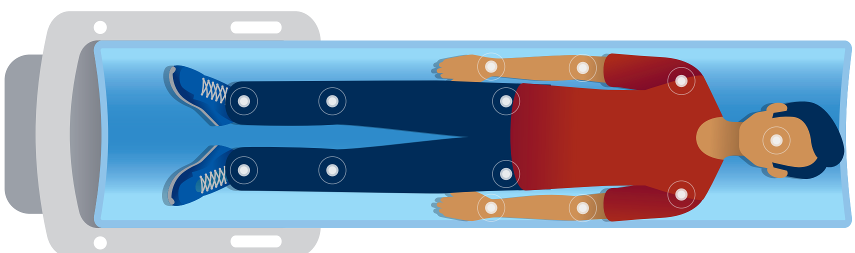


Figure 2 Representation of body landmarks used in the surview range regression model to predict and present surview start and end positions. The Precise Position AI algorythm automatically detects 13 anatomical landmarks.

Results from case studies are not predictive of results in other cases. Results in other cases may vary.

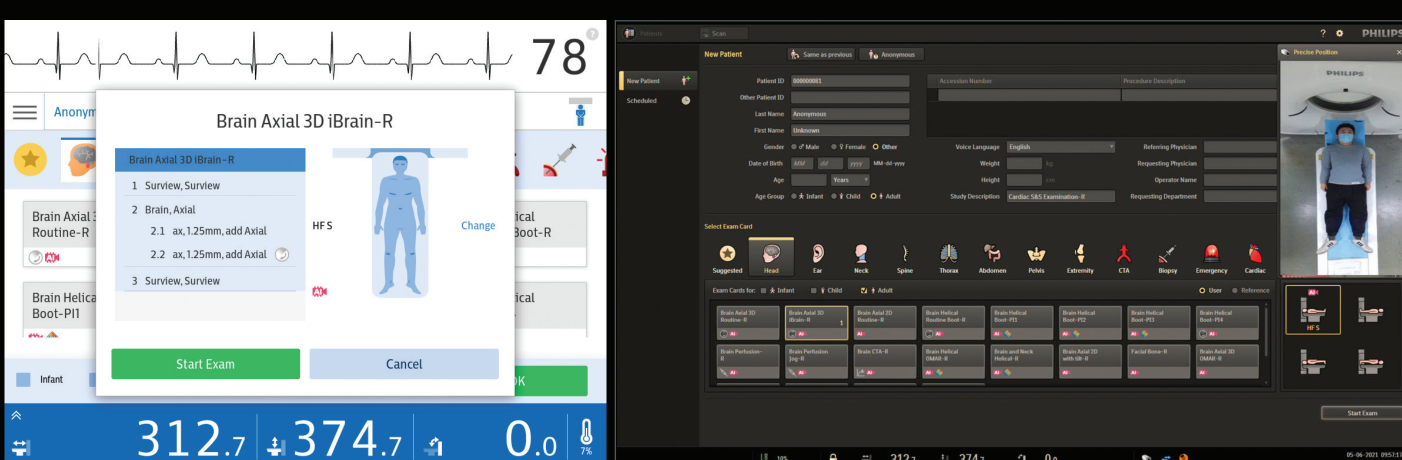
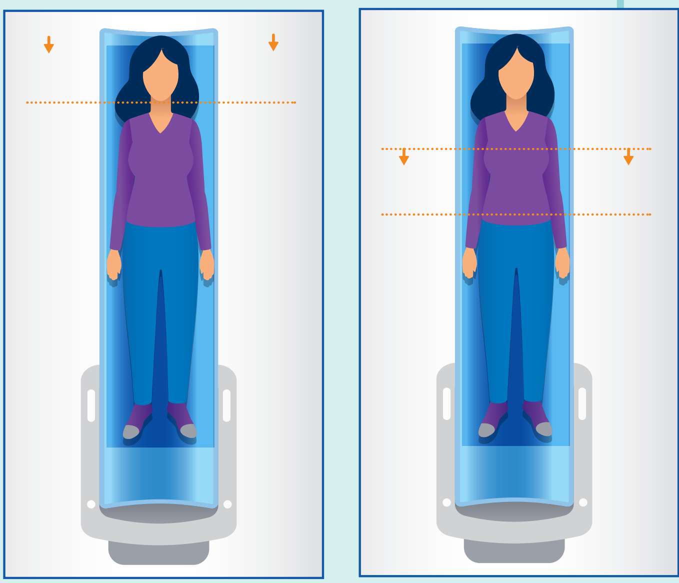


Figure 3 The flexibility of camera workflow both on the console and at the gantry allows for fast and consistent positioning.

Precise Position **combines ease and accuracy****



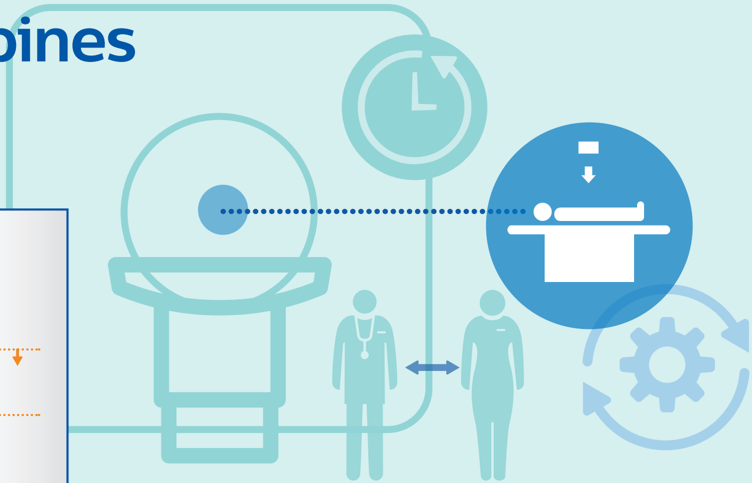


Figure 4 Automated planning of surview start and end positions for a head (left) and abdomen (right) exam.

**Based on Philips internal assessment by five clinical experts, comparing manual positioning versus Precise Position in 40 clinical cases using a human body phantom.

- **Automatically selects patient orientation** in prone or supine position with no need for manual adjustment
- **Automatic selection** of surview start and end positions with no need for manual adjustment
- **Reduces** patient positioning time by **up to 23%**
- **Improves** accuracy of vertical centering relative to manual positioning by **up to 50%**
- **Increases** user-to-user consistency by **up to 70%**

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50% improvement in vertical planning accuracy

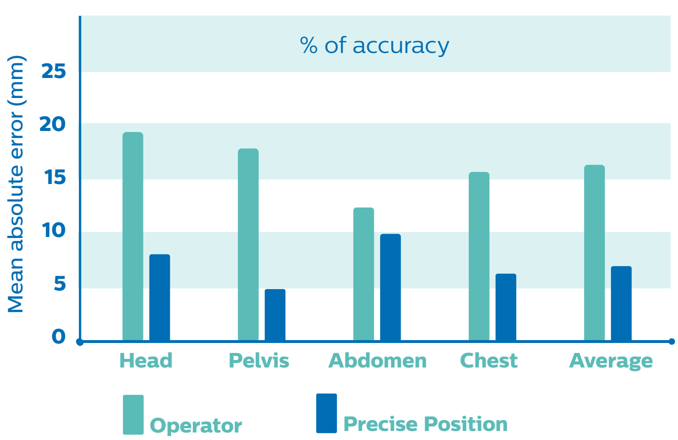

Figure 6 Vertical planning accuracy per target anatomy, showing mean absolute error for operators alone compared to using Precise Position.

70% increased vertical planning consistency

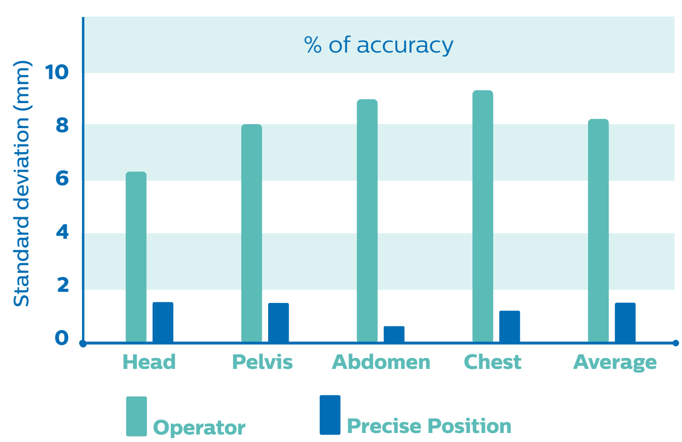

Figure 7 Vertical planning consistency per target anatomy, showing standard deviation for operators alone compared to using Precise Position.

COVID-19 has changed the way we look at physical distancing

Because patient orientation, vertical centering, and surview start and end position are entirely automated with Precise Position, the technologist can also perform this portion of the workflow from the CT control room. This provides advantages in terms of decreasing time spent and direct contact with the patient in situations where it is recommended that it is crucial to limit exposure of healthcare workers, employees and patients to each other.[5] Without Precise Position, patient positioning for a CT exam often requires close physical contact between patients and healthcare providers. In situations such as in a pandemic, physical distancing (maintaining six feet of space between individuals) should be practiced as an important strategy to prevent transmission of infectious diseases such as COVID-19.[6]

Conclusion

It is critically important that patients are positioned properly during a CT exam in order to avoid unwanted consequences such as increased radiation dose to the patient and image noise. The innovative technology of Precise Position automates conventional workflows and has great potential to improve throughput and enhance patient satisfaction and the staff experience. Precise Position also provides clinicians with the ability to perform portions of the CT workflow entirely from the CT control room, which is an important strategy in limiting exposure of both clinicians and patients to infectious disease. Precise Position is able to deliver on all of these challenges through intellect at every step, and by delivering intelligence that adapts to the user.

*We embrace the following formal definition of AI (source: HLEG definition AI). Artificial intelligence (AI) systems are software (and possibly also hardware) systems designed by humans that, given a complex goal, act in the physical or digital dimension by perceiving their environment through data acquisition, interpreting the collected structured or unstructured data, reasoning on the knowledge, or processing the information, derived from this data and deciding the best action(s) to take to achieve the given goal. AI systems can either use symbolic rules or learn a numeric model, and they can also adapt their behavior by analyzing how the environment is affected by their previous actions. As a scientific discipline, AI includes several approaches and techniques, such as machine learning (of which deep learning and reinforcement learning are specific examples), machine reasoning (which includes planning, scheduling, knowledge representation and reasoning, search, and optimization), and robotics (which includes control, perception, sensors and actuators, as well as the integration of all other techniques into cyber-physical systems).

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