

High Energy Research Facilities

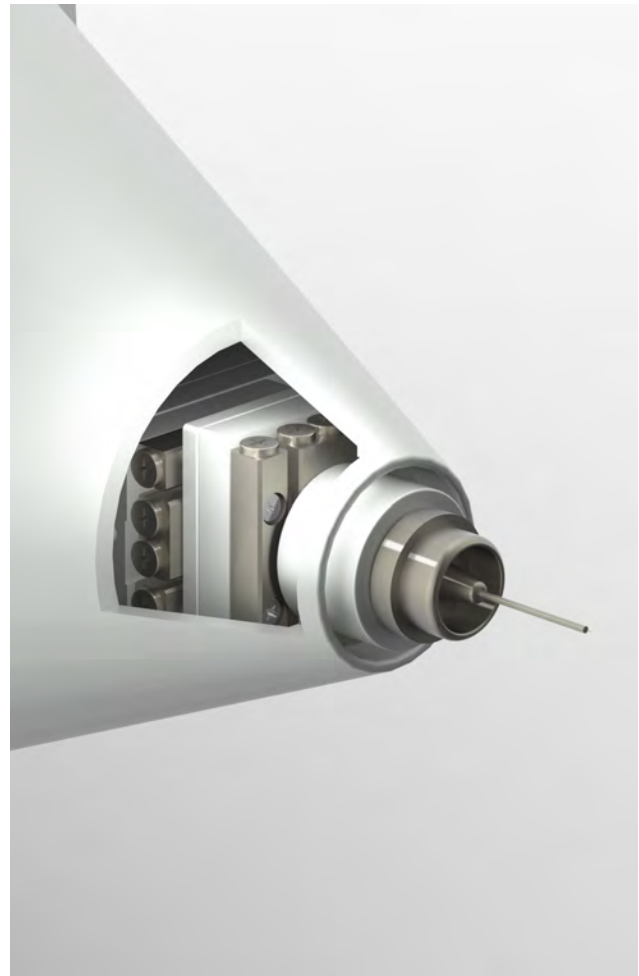


High Energy Research Facilities

Top notch research is, and always has been, a key driving force for innovation and invention. Founded as a university spin-off, research and engineering build the foundation of SmarAct's success. Given those roots, we at Smaract are proud to support researchers all around the globe, advancing their scientific achievements with our expertise in high precision positioning and metrology technologies.

High Energy Research Facilities such as particle accelerators, synchrotrons, free electron lasers, X-Ray optics or crystallography experiments require unique and custom positioning solutions. Complex movements with multiple degrees of freedom, accuracies down to the micro- or nanometer range and rotational positioning with low eccentricity meet extreme environmental conditions like ultra-high vacuum surroundings, wide temperature ranges or the presence of magnetic fields.

Smaract's flexible in-house production combined with our design-, engineering- and validation capabilities enable us to be a reliable partner for exactly those projects. Whether you need a single positioner, a complex positioning solution or a custom robotic system – we offer the expertise to find the ideal approach for your application.



Correction of Eccentricity During Rotations

Today's synchrotron, Nano CT and Macroscopic Protein Crystallography facilities face similar opportunities approaching the new era of fourth-generation synchrotron radiation. As the increase in brilliance and beam quality offers faster data acquisition, positioning solutions at beam lines are challenged to provide improved accuracy, stability and speed. This requires precise and fast rotation of samples with sufficiently low eccentricity below the 1 μm -scale to ensure position stability within a highly focused (X-ray) beam. SmarAct has extensive experience in the fabrication of such demanding positioning solutions using in-house fabricated linear and rotary nano stages. Application specific combinations of single axis stages are used to achieve precise positioning, to meet the most

demanding requirements. In collaboration on various projects, customers such as the Fraunhofer Institute for Integrated Systems (IIS), the University of Lund at Max Lab, Shanghai Synchrotron and Radiation Facility and Brookhaven National Lab commissioned systems with various levels of integration to develop and continuously operate solutions for research and developmental purposes benefiting from our experience with custom applications.



Multi Axis Positioning Systems

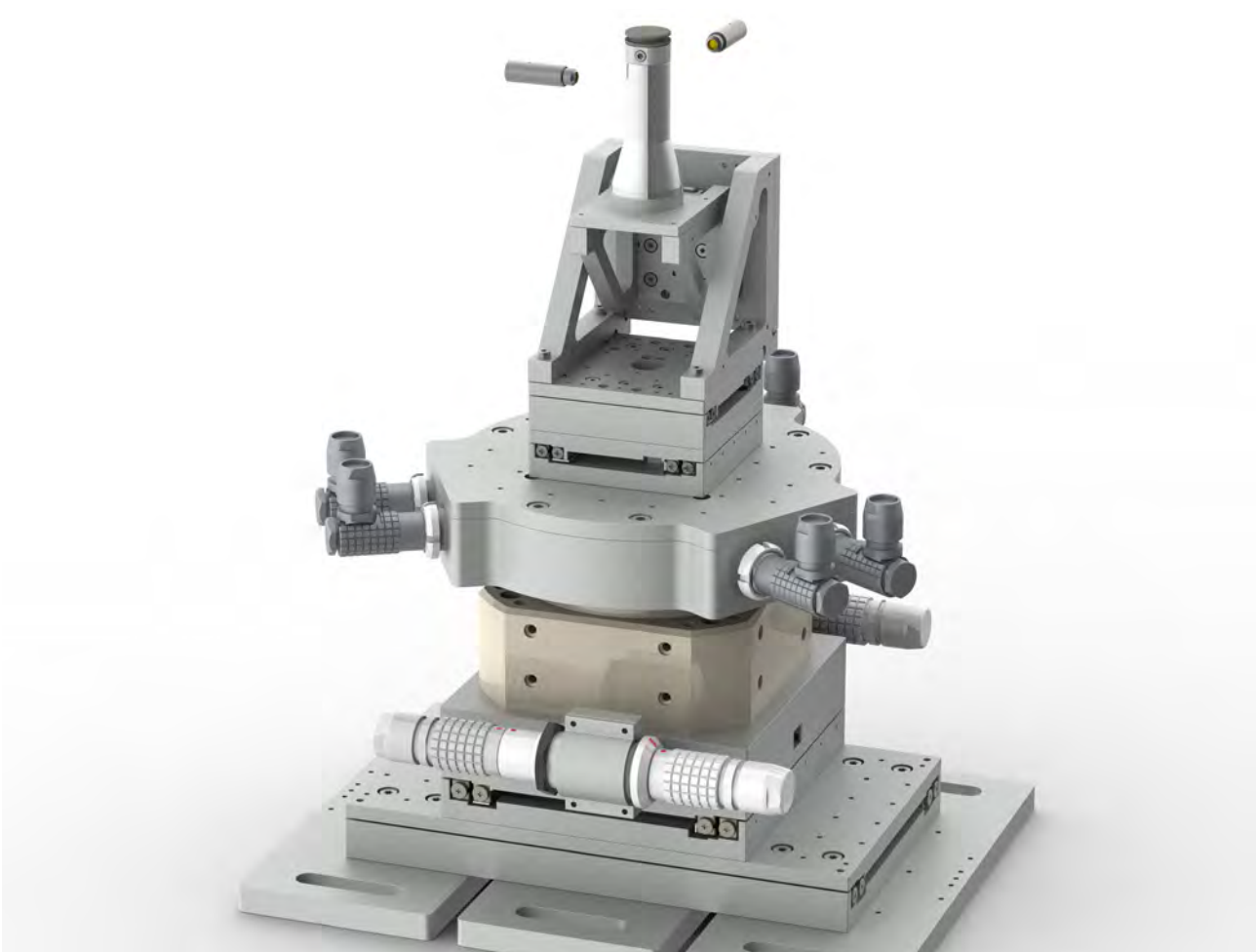
The pictured multi-axis positioning solutions provide highest precision capabilities within the nanometer range using SmarAct's piezo stick-slip positioners, while achieving macroscopic travel ranges of several centimeters, to enable coarse and fine alignment of the sample within the beam. We can provide positioning systems with various degrees of freedom

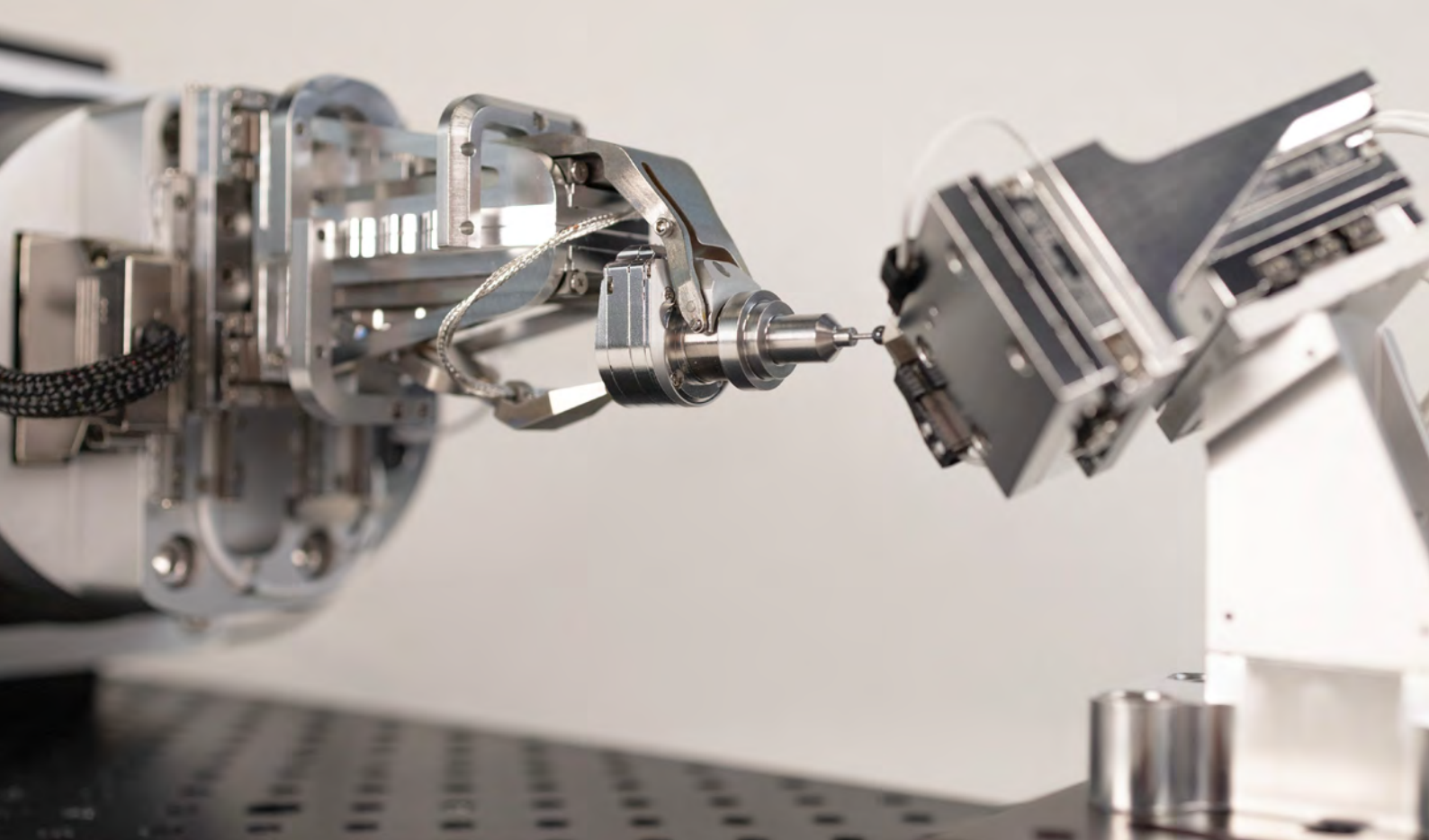
from single axis positioners, over basic XY-setups, to 6 DoF multiaxial parallel kinematics and complete customized installations. They can be designed to align small diffraction samples of a few grams within an external cryo-stream or to tip-tilt and position extensive loads of complex sample holders with integrated cryo-coolers of up to several kilograms.

Active Compensation

Sample positioning to correct eccentricity errors are typically performed by linear XY-stages on top of the continuously rotating parts. While simple eccentricity compensation approaches via compensation tables were sufficient in the past, modern setups increasingly require live correction of eccentricity and tilt-errors. Consequently, multi-axis positioning solutions on top of rotation stages exceeding 360° are required. The resulting electrical integration of such complex positioning solutions with continuous rotations demand extensive integration effort and large installation spaces. Realizing the need for innovation, SmarAct offers compact, reliable solutions with standardized interfaces and support for up to six degrees of freedom position systems. All necessary sensor electronics

are integrated into the air bearing connectors design, whose modular approach allows flexibility in air bearing and slip-ring choice. As the piezo scan range of SmarAct's piezo drives exceeds the eccentricity error of commonly used air bearings they are the ideal choice for quick, responsive, and active compensation. Such active position correction algorithms can be devised either by programmed look-up-tables, which can be generated by a provided calibrator, by capacitive sensors or performed with support of SmarAct's **PICOSCALE Interferometer**. To provide a complete solution, SmarAct uses high precision cylinders as reference to integrate active interferometer-based compensation. Individual subcomponents to retrofit already existing setups can also be provided.



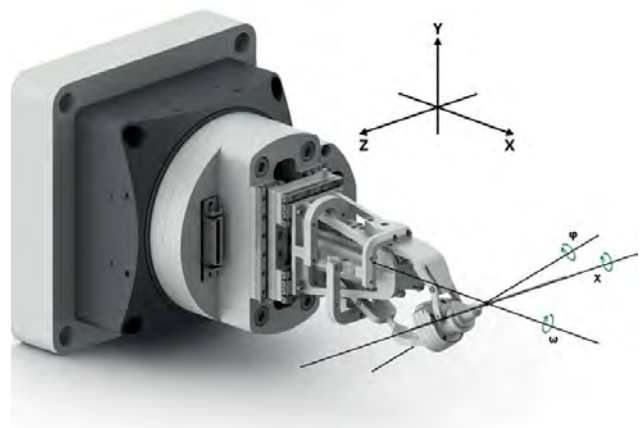


Crystallography

Highest precision, durability and reliability are the top priority properties when selecting positioning equipment for the use in science and industry. SmarAct's design of a robotic positioning system with six degrees of freedom, capable of tackling various positioning tasks in experiments or micro-assembly setups, was developed as the standard solution in the field of protein crystallography. Its revised design, optimized for a slim silhouette and minimal shadowing around the tip, allows for large rotary angles, even in confined spaces.

With the innovative smart automated calibration routine, utilizing SmarAct's newest controllers and motion control capabilities, it achieves a "sphere of confusion" in the single-digit micrometer range for all rotary axes. With our in-house solution, the need for integration by the user is minimal, allowing for reliable turnkey operation.

The **SMARGON**[®] is a positioning system with six degrees of freedom based on a combination of serial and parallel kinematics mounted to a heavy-duty rotation stage, defining the ω -axis of the device. This rotation platform can either be a Direct-Drive or a piezo-driven stage. The sophisticated hybrid kinematic approach allows an end effector to be positioned in X, Y and Z direction and to be rotated in χ -, φ - and ω -direction.



With the development and production of market-leading solutions in the field of high-precision positioning, automation and metrology, the SmarAct Group reliably accompanies their customers in achieving their goals. The broad product portfolio – from single positioning stages to complex parallel kinematics, miniaturized robots, control systems and measurement technology – is complemented by automated microassembly solutions. Even the most challenging customer requirements can be met by maximum adaptability and complete in-house production.

Since its founding in 2005, SmarAct has steadily grown from a small team of engineers to a group of companies with three independent business units and over 270 highly skilled members. Today, SmarAct relies on years of experience and, above all, on a very passionate team with unconditional customer focus.

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