Nanopositioning instrumentation in 2013

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Since nanopositioning is a relatively young technique, it is very hard to predict the future performances of the nanopositioning instruments five years from now. This brief writing is based on today's technical challenges and tries to project the future performances and capabilities of the nanopositioning instrumentation for synchrotron radiation applications in 2013. For the APS synchrotron radiation instrumentation development, if there are no commercial products available, a customized device will be developed with modular design consideration to improve cost effectiveness and cross application compatibility.

- Advanced linear encoders and angular encoders

  Performances of optical linear encoders will continue to improve with finer grating scales and advanced readout electronics. Nanometer resolution will be a standard for many products, and sub-nanometer resolution will be possible for grating encoders, but their accuracy can not compete with that of laser-interferometric encoders. Laser-based encoders with integrated multi-reflection optics will reach picometer level resolution for linear encoder and sub-nanoradian level resolution for angular measurement.

- Novel linear stages and angular stages

  New type of weak-link stages will provide precise and vibration-free motion guiding systems for linear stages and angular stages. PZT-based motion driver will provide sub-nanometer level motion control with centimeter level travel range.

- Multidimensional positioning with sub-nanometer resolution

  FPGA-based controller will provide multidimensional positioning control in sub-nanometer level with centimeter travel range.

- New concepts for six degree-of-freedom positioning and measuring

  Direct positioning and measuring a target with six degree-of-freedom might be improved to the sub-micron level.

- Nanopositioning with extreme environmental conditions

  More nanopositioning devices will be compatible with extreme environmental conditions, such as ultra-high-vacuum, cryo-temperature, high-magnetic field etc.