Introduction
The scientific community and with it, every researcher, should be committed to sharing the aesthetics of microscopic structures, with as many people as possible.

In the past it was mostly still shots of the specimen that were available. We thought it would be worth it to bring movement, color and lighting effects into the microworld and so developed a modular software called “nanoflight.creator” [1] with the goal of taking control of parameters like specimen movement, detector values, focus and colors of each detector channel in the scanning electron microscope (SEM).

Development of the Control Software – A Challenge!
We have different levels of software modules: extensions for proprietary hardware like specimen stages, remote functions on the SEM and so on; live-controllers to control this hardware; add-ins like timelines, to control the execution of programmed sequences within the overall time-schedule; pre-effect plug-ins like Autofocus and after-effect plug-ins like color-correction or sharpen.

Within each timeline, the user can read, correct and send microscope values in correlation with sequence time, thereby setting up multi-dimensional way-points. Frames between these way-points are automatically generated with different possibilities of interpolation and graphic manipulation “on-the-fly”, where applicable using multi-dimensional splines to get smooth curves and functions.

All these target-point function values are represented by vectors in a multi-dimensional space that stand for the settings of all axes used. We use eight motorized axes, three with the motor-stage of the SEM and five with the piezo-controlled eucentric substage. Within the image sequence we send out more than forty hardware-specific parameters per frame.

Acknowledgements
We are indebted to: Prof. Hubert Mantz, University of Applied Sciences, Ulm, for his help concerning the spline routine; Kleindiek nanotechnik, Reutlingen for making the Substage available for this project; pointelectronic, Halle for their help modifying the DISS scanning software to be remotable; Max Holder, IRIS Solutions, Würzburg for all the months of hard working on the creator software.

References
[1] Magnification, Focus, Gain and Blacklevel add-on units made by Heiland electronic GmbH, Wetzlar, Germany
[2] ESAT Piezo Stage made by Kleindiek nanotechnik, Reutlingen, Germany
[3] nanoflight is a registered trademark of Stefan Diller, Würzburg, Germany
[4] Developed by Max Holder, IRIS Solutions GmbH, 97070 Würzburg, Germany
[5] „3dconnexion“ is a trademark of 3Dconnexion, 330 Bear Hill Road – Suite 301, Waltham, MA 02451, USA

Conclusions
The software can be used to remotely control the SEM in all the accessible functions available within the extension modules. The “nanoflight.creator” has a very extensive framework to facilitate programming of own extensions for specific hard- and software.

The “nanoflight” are still a “project under construction” and depend on the availability of modern hardware for nearly-analog viewing of the SEM sequences (field emission microscopes...). Anybody interested in this visual approach is invited to join us. My personal wish would be that the response of stage movements become so fast that multidimensional encoded tracking and spline-generation be possible on the fly. That would enable users to really “fly around” microstructures using even lower image resolution and still get impressive image tracking for the high-resolution scans.

Some of the resulting nanoflight SEM movies can be seen on „http://www.nanoflight.info“ or „https://vimeo.com/stefandiller“.

We hope you enjoy this new way of visualization.

Contact: diller@stefan-diller.com, max.holder@iris-solutions.de, mantz@hs-ulm.de, grodler@gmx.de, mz@pointelectronic.de, wj@pointelectronic.de, jh@heilandelectronic.de, klausschock@kleindiek.com

Address: Stefan Diller - Scientific Photography, Arndtstrasse 22, D-97072 Würzburg

The nanoflight system [3] integrates and remotes equipment from different manufacturers:
- FEI / Philips S2S Large Chamber SEM
- Kleindiek Eucentric ESAT Substage
- Heiland Electronic Remote Modules
- DISS5 Scanning System
- Up to eight SE and BS detectors
- nanoflight.creator software [4]
- Used post processing software: Adobe After Effects, Premiere

More than 40 parameters per frame will be sent during the „flightpath“ around the microstructures. A 4-channel frame rate at HDTV resolution takes 80 sec scanning and manipulating time.