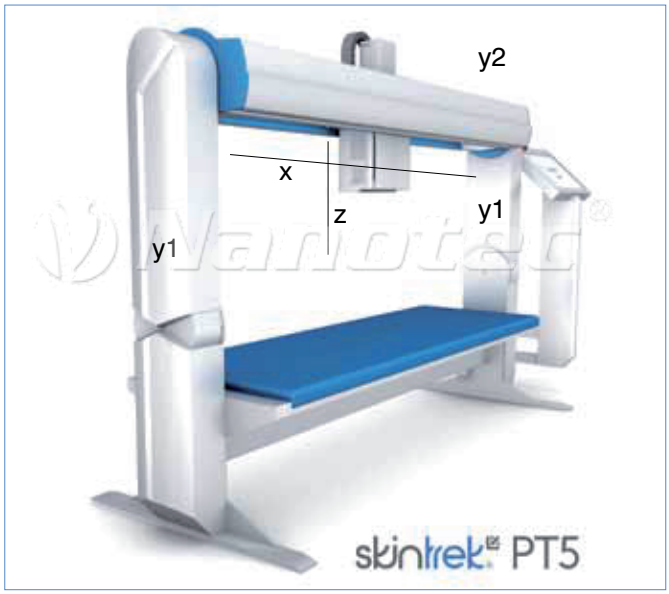
Application example: Lüllau Engineering relies on high-precision stepper motor technology for the skintrek® PT5 phototherapy device

The skintrek® PT5 medical UV radiation device is the most innovative technology currently available on the market for irradiating skin diseases. It became apparent during development how important simple component interchangeability is.

There are two phototherapy processes for providing UV radiation for skin diseases such as psoriasis, vitiligo and eczema: a normal one where the skin is irradiated with a floodlight and a digital one. In this latter case, the UV radiation is converted into a pixel matrix. The individual beams controlled independently from each other only expose areas of skin afflicted with the disease.



"During treatment it is important that as little healthy skin as possible is irradiated in order to minimize the risk of skin cancer," explains Graduate Engineer Friedrich Lüllau, who is considered the grandfather of digital phototherapy. This put the goal of development for the new skintrek® PT5 UV radiation device in clear focus: No healthy skin should be irradiated, even if the patient moves. The exposure head has to be able to follow the slightest movements.

This four-dimensional mobility was realized using high-precision stepper motor technology. Seven Nanotec stepper motors plus control systems are in the device. Plug & Drive motors were primarily used; they integrate the motor, the control system and the encoder into their housing. Advantage: Low wiring effort. "You only need the power supply and interface cables; motor and encoder lines are integrated," says R&D Manager Dr. Matthias Kock.

Same-sized hole, twice the holding torque

A PD4-N6018 model with 3.54 Nm of holding torque is located in the crossbeam (Y2 axis) where the exposure head is housed. This drive made it apparent how quickly the actual performance requirement can differ from plans. In particular, the holding torque of the originally preferred PD4-N5918 variant was not enough during real-world testing. Instead of 1.5 Nm, 3 Nm were required. The result was almost twice the holding torque with just a 4 mm x 4 mm larger size and the same-sized hole, without the need for expensive redesigning. The motor functions as a swivel drive that can rotate the exposure crossbeam to 20° degrees on each side in order to cover the side areas of the body with precision.

The exposure unit (Y1 axis) is adjustable around a pivot point at the height of the bed so that the exposure head covers all of the areas of the body, even the sides. An autonomously running, but synchronously switched, PD4-N5918 Plug & Drive motor is on each side. The exposure head is stored in the cross member, together with the UV light source, color filter disk, light modulator and camera. The radiation from a UV light source is bundled by a collimator and filtered as needed or by adjustment so that either UVA radiation with a 320-400 nm spectrum reaches the digital light modulator or UVB radiation with a 300-320 nm spectrum. The beam of light is digitized into approximately 800,000 individual beams (pixel beams). The pixel beams that correspond to afflicted areas of the skin are then switched on based on image recognition combined with a dosage calculation.

Closed loop for smooth-running operation

There is a color filter between the light source and the light modulator. Depending on the skin disease being treated, the color filter disk puts a color spectrum into position for the exposure with the aid of ST2018 stepper motors controlled using a controller developed in-house. The exposure unit can move back and forth in the crossbeam (X axis) and its height can be adjusted (Z axis). In order to provide uniform drive architecture, a PD4-N5918 motor was chosen for the X-axis as well. The height is configured using two ST4118 stepper motors plus a SMCI47 control system, combined with a linear slide, in closed loop mode.
The skintrek® PT5 has been on the market since the beginning of 2012. Looking back on 2 years of development time, Dr. Matthias Kock concludes, "It was the right choice. Cooperating with Nanotec was very productive and effective. The motors also exhibit very quiet running behavior in closed loop mode."

Photos: Lüllau Engineering