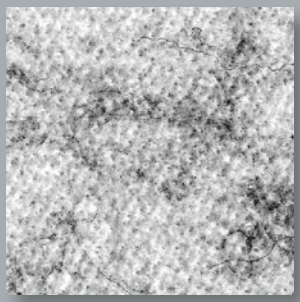

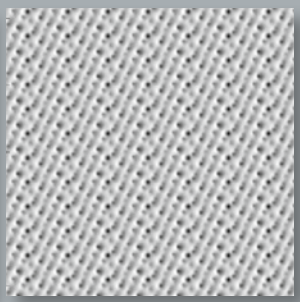

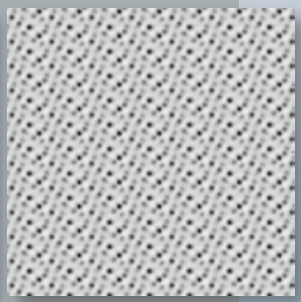

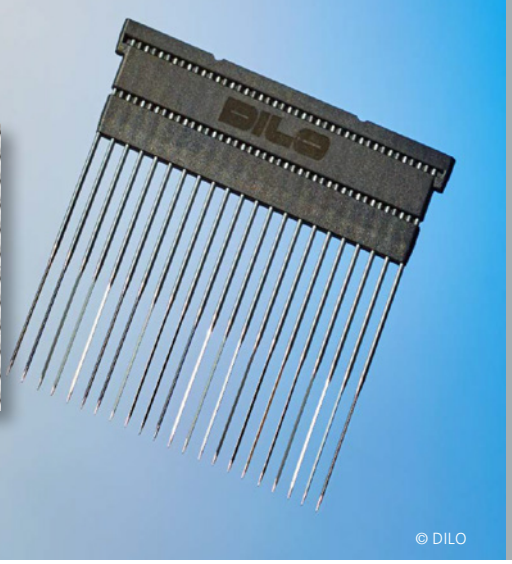

1 2 3 4

ADAPTIVE NEEDLE LOOMS

1 *Needled nonwoven fabric*

2 *Penetration pattern after image processing*

3 *Simulated penetration pattern*

4 *Needle modules*

The Dilo Group in Eberbach, Germany develops and produces innovative systems for the nonwoven materials industry. Needle punch systems used for mechanical bonding of nonwoven fabrics play a major role in their business. We assist Dilo in the development of Variopunch, a needle punch technology that will contribute to a more uniform penetration pattern. The process is described below.

Dilo-Variopunch – adaptive needle punch technology

A large number of needles are arranged in a repeating pattern on a needle board. The needle board continuously moves vertically in and out as the nonwoven material is transported underneath. As a result, the individual fibers are locked together giving the fabric strength. Besides strength, the optical impression also plays a crucial role for many applications because the needle punch inevitably leaves a pattern.

The needles have traditionally been positioned at fixed points on the needle board. The new Variopunch technology being developed at Dilo enables adaptive needle positioning. In a typical line of needle looms, several machines are placed in succession and operate in a sequence of decreasing intensity so as to produce a pattern that is as homogeneous and streak-free as possible. A significant increase in quality is achieved by placing a Variopunch machine with variable positionable needles at the end of such a line, which corrects previously occurring errors through adaptive needling.

Image processing, simulation, and optimization

Our institute supports the development of the Dilo Variopunch, especially in the algorithmic implementation. We use techniques from the fields of image processing, simulation, and optimization. An optical sensor located at the front of the machine scans the incoming fabric. The resulting images are processed algorithmically and the pattern is extracted. By means of simulations we can compute the resulting pattern for any possible positioning of needles in the Variopunch board. Optimization methods are then applied to determine the optimal punch positions and, accordingly, use them to adapt the needle board.