GEN3 PARTNERS

Client Case Study
"Seeing" Through Walls

Background

A large European firm specializing in electric hand tool production asked GEN3 for help to improve the impact drill developed by the company. The existing design was exceptionally good for piercing concrete, but was unsuitable for making holes in bricks because the bricks were pulverized by the force of the impactor.

Because of this problem, workers had to carry two different drills to the worksite – an impact drill for concrete and a less efficient conventional drill for bricks. The client asked GEN3 for a solution that would provide better control of the impact energy developed by the drill.

The Solution

GEN3 developed a Substance-Field model for this drill and identified the pneumatic force field used to drive the impactor portion of the drill as detrimental to the function. This quickly led them to seek an alternative field mechanism to substitute for the pneumatic system.

They subsequently proposed a new operating principle for the impactor — to employ a **controllable electromagnetic field** instead of pneumatics. A prototype of a new impact drill using this action principal was designed, manufactured and tested as part of this project. It worked successfully and solved the problem.

A second approach to controlling this drill was also developed, one that is particularly novel and interesting. GEN3 proposed that a new action principle for driving the impactor could be created by making the drill head from **hyper-elastic metal with shape memory** and controlling the impact frequency of the impactor by controlling the temperature of the head.

Very small changes in temperature around the transition point would cause the impactor to rapidly cycle between two lengths, thus providing the impacting motion. Controlling the frequency of temperature changes would control the impact dynamics.

To the best of our understanding, this was the first use of shape memory alloys in electric tools of any kind. GEN3 manufactured an experimental prototype of this device and tested it, verifying that the action principle worked as expected.

Encore

Based on the success of the first effort, the client asked GEN3 to create a device which would be able to detect the presence of cables, tubes, fittings and other extraneous objects located inside walls as a way to avoid unnecessary damage to utilities or accidental injury to workers during construction.

GEN3 responded with a device based on **an ultra-broadband locator and an antenna having a distributed aperture**. This locator probed the wall with ultra-short pulses and analyzed reflected signals. Using this technology, the locator was able to determine:

- distance to an object
- material type of the object (metal or dielectric).

This locator was compact, both in terms of dimensions and weight, comparing very favorably with similar products then offered on the market. And in terms of cost, it appeared to be approximately two orders of magnitude less expensive than the competing products. Connecting a computer with specialized software to the locator made it possible to display the cross-section of a part of a wall, with internal objects and their exact locations clearly displayed on the screen.