



## SOUND

# Spatio-temporal inverse filtering turns surfaces into speakers!

Making all types of surfaces multifunctional, such as screens, tables, partitions or vehicle windscreens, made of passive materials like wood, carbon fibre, aluminium or glass. Researchers at Carnot CEA LIST Institute have used localized haptic feedback to develop the Sound system, which can integrate sound into any surface. This paves the way for some very creative and promising applications.

Carnot CEA LIST Institute

### Scientific / technological breakthrough

Researchers from Carnot CEA LIST Institute developed a vibro-tactile feedback technology for smartphone screens back in 2016. It is based on spatio-temporal inverse filtering and can localise acoustic waves in an unknown non-homogeneous material using a group of piezoelectric ceramic or electrodynamic shaker actuators.

The key here is localized haptic feedback.

The technique was then transposed to design sound-emitting surfaces.

This technology makes it possible to locate and control vibrations precisely, and therefore to produce sound wherever it is wanted: it becomes easy to transform any surface into a speaker.



### Competitive advantage for the economic stakeholders

Beyond its ability to turn a surface into a working speaker, SOUND's advantages lie in reducing the weight, volume and number of devices used, as well as in ease of deployment and maintenance. Whether we take integrated car speakers or dashboards with invisible buttons, SOUND frees OEMs from many technical constraints. Our speakers save 80-95% in terms of volume, and are 50%-90% lighter than those currently used.

Although SOUND initially focused on sound reproduction, its sleek functional surfaces open up a world of creative opportunities for new applications: medical devices, home automation, interfaces in public places, transport or museums.

