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Technion Research & Development Foundation

Technion - Israel Institute of Technology
Senate Building
32000 Haifa. Israel

T/ +972.4.829.4851
F/ +972.4.832.0845
T3info@technion.ac.il
www.t3.technion.ac.il

TECHNION REF:
COM-1080

Pinpoint Microphone

Categories:
Computer Science
Signal, Audio and Image Processing,

Technical Keywords:
Interferometry, phase shifts, signal noise, multi-phase interferometry, speckle

Market Keywords:
Hearing aid, pinpoint microphone, long-range microphone, surveillance equipment, surveillance, amplifiers,

Contact:
Inbal Lev,
inball@dp.technion.ac.il

The intuitive pin-point selection of an individual within a crowd to detect their voice has several important applications from highly directional hearing aids to eavesdropping on, or identifying a suspect in public. This invention detects sound at a distance with the required sub-nanometer sensitivity, surmounting the inherent difficulties of optical detection of reflections from scattering surfaces, unstable detection geometries, environmental disturbances and background interference.

Background

The ability to detect the voice of an individual within a crowd has several important applications. These range from offering the long-sought, truly-directional hearing aid for the hearing impaired to gathering intelligence on a surveillance target suspect in public for homeland security. The disappointing performance of microphone arrays in such applications draws attention to the excellent directionality of optical methods in which the desired sound source can be targeted simply by training a light beam on it. The intuitive pin-point selection of an individual within a crowd with a light beam requires sub-nanometer sensitivity to detect the minute vibrations of an acoustic source, while operating in a noisy environment, off of human skin, which is both rough and in constant motion on scales that are many orders of magnitude greater than the signal. When training an optical beam onto a person, the roughness of the skin scatters the interferometric beam, significantly degrading the signal quality and even if a person is standing still, their millimeter- scale, random movements upset the interferometric setup which requires sub-micrometer stability. Conventional interferometric methods are sensitive enough, but cannot operate off of an unstable, rough surface or within an uncontrolled environment.

Method

The invention incorporates a detection scheme with a detector array that overcomes the difficulties encountered with state-of-the-art interferometers: compensation for detection distance instability and a reconstruction of randomly phased interferometric elements due to scattering on the detection surface to extract an enhanced signal. The method also suppresses background noise, detecting only the sound generated by the source illuminated by the detecting optical beam. The invention utilizes readily available components allowing a low-cost and simple implementation.

Advantages

- Ability to pin-point an individual sound source in a crowd, detect sub-nanometer vibrations from this source and reconstruct the related acoustic signal, with excellent background noise suppression, regardless of roughness of the source's surface or its random movements.
- Low-cost and easily implementable solution utilizing off-the-shelf components

Applications

- Highly directional hearing aid for the hearing-impaired that allows pin-pointing an individual in a crowd with whom to conduct a conversation in a noisy environment
- Intelligence gathering device for eavesdropping on an individual in a crowd
- Surveillance equipment used to pin-point and identifying an individual in public

Patentportfolio