Sound

1-Acoustic metamaterials for sound absorption and insulation in buildings

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Source BUILDING AND ENVIRONMENT Volume 251 DOI 10.1016/j.buildenv.2024.111250 Article Number 111250 Published MAR 1 2024 Early Access JAN 2024 Indexed 2024-03-06 Document Type Article

Abstract

Despite the emergence of acoustic metamaterials with superior sound absorption and transmission loss, their adoption for building sound insulation has been limited. Sound insulation design in buildings is still informed by the acoustic performance of conventional materials, where the mass law contradicts light weighting when it comes to acoustic design. In any case buildings close to noisy environments such as motorways, railway lines and airports still suffer from significant low frequency noise pollution. Although the limited working bandwidth of acoustic metamaterials is a major issue limiting its application, combining meta-units that interact at various frequencies alongside multi-layer conventional solutions can deliver superior sound insulation in buildings. The review put forwards acoustic metamaterials, specifically emphasising superior sound absorption and transmission/insertion loss as critical properties for effective building sound insulation. The paper reveals a variety of acoustic metamaterials that can be adopted to compliment conventional sound insulation approaches for acoustically efficient building design. The performance of these metamaterials is then explained through their characteristic negative mass density, bulk modulus or repeating or locally resonating microstructure. The review is also extended to air transparent acoustic metamaterials that can be used for sound insulation of building ventilation. Lastly the prospects and challenges regarding the adoption of acoustic metamaterials in building insulation are also discussed. Overall, tuneable, and multifunctional acoustic metamaterials when thoughtfully integrated to building sound insulation can lead to significant acoustic comfort, space-saving and lightweighting.

Keywords
Author Keywords
Acoustic metamaterialsSound insulationSound reductionVentilationBuilding design

Keywords Plus
NOISE-CONTROLDESIGNMETASURFACEMODELATTENUATIONINDEX

Sound

2-Multifunctional subwavelength device for wide-band sound absorption and acoustic-electric conversion

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By Yuan, M (Yuan, Ming) [1] ; Zhu, B (Zhu, Bo) [1] ; Jiang, QS (Jiang, Qingsong) [1] ; Xie, YN (Xie, Yannan) [1] ; Ohayon, R (Ohayon, Roger) [2] (provided by Clarivate) **Source SENSORS AND ACTUATORS A-PHYSICAL Volume 389 DOI 10.1016/j.sna.2025.116554 Article Number 116554 Published AUG 1 2025 Early Access APR 2025 Indexed 2025-04-27 Document Type Article**

Abstract

Multifunctional acoustic devices, pivotal for advancing smart, compact systems, have attracted considerable interest due to their capacity to manipulate sound waves and deliver tailored functionalities. This study introduces a subwavelength acoustic device engineered with multifunctional interfaces that concurrently achieve sound absorption and acoustic-electric conversion. Departing from conventional local resonance-based absorbers-limited to single-peak low-frequency absorption-the proposed design enables effective low-frequency absorption and broadband performance (810-1600 Hz). This is realized through a synergistic architecture combining a slit-panel structure and a porous material, the latter shielded by an acoustic wire mesh to mitigate environmental contamination. Additionally, an acoustic nanogenerator, integrated with the slit panel and mesh, adopting contact electrification between materials with contrasting triboelectric properties to generate electricity. Experimental validation confirms the acoustic absorption performance and the successful acoustic-electric conversion, with peak voltage output occurring near the device's resonant frequency. By integrating noise reduction and acoustic-electric conversion within a compact device, this work contributes to the development of multifunctional acoustic systems for self-powered applications and integration within smart environments.

Keywords

Author Keywords

Acoustic absorptionMultifunctional acoustic deviceAcoustic-electric conversionAcoustic triboelectric nanogeneratorSelf-powered device

Sound

3-A Survey on Channel Sounding Technologies and Measurements for UAV-Assisted Communications

By Mao, K (Mao, Kai) [1] , [2] ; Zhu, QM (Zhu, Qiuming) [1] , [3] ; Wang, CX (Wang, Cheng-Xiang) [3] , [4] ; Ye, XC (Ye, Xuchao) [1] ; Gomez-Ponce, J (Gomez-Ponce, Jorge) [5] , [6] ; Cai, XS (Cai, Xuesong) [7] ; Miao, Y (Miao, Yang) [2] ; Cui, ZZ (Cui, Zhuangzhuang) [8] ; Wu, QH (Wu, Qihui) [1] ; Fan, W (Fan, Wei) [9] **(provided by Clarivate) Source IEEE TRANSACTIONS ON INSTRUMENTATION AND MEASUREMENT Volume 73 DOI 10.1109/TIM.2024.3436128 Article Number 8004624 Published 2024 Indexed 2024-09-16 Document Type Article**

Abstract

Unmanned aerial vehicles (UAVs) have been widely used in both military and civilian applications, where a stable communication link is vital for safe flight control and robust data transmission. To develop a reliable UAV communication system, it is necessary to deeply understand the UAV channel characteristics and establish accurate channel models. Channel sounding is the most effective way to obtain realistic channel characteristics and validate the theoretical channel model. However, the studies on UAV channel sounding are still insufficient in terms of system design and data processing due to the complexity of developing a UAV channel sounder. Different from the terrestrial channel sounders, the implementation of a UAV channel sounder is tortured by the limited battery life and payload capacity of the UAV platform. The sounding scheme and data postprocessing also need to be specially designed for highly dynamic UAV channels. So far, most existing survey studies on UAV channels focus on modeling methodology and model presentation. To fill this gap, this article provides a comprehensive survey on the design of the UAV channel sounder, in terms of the hardware scheme, sounding signal, time synchronization, calibration, and data postprocessing. Current issues and potential research topics behind existing sounding technologies and measurement campaigns are analyzed. Moreover, future challenges and open issues are also discussed.

Keywords

Author Keywords

Autonomous aerial vehiclesAir to ground communicationChannel modelsSurveysHardwareBatteriesQuadrotorsChannel sounderchannel soundingsounding schemesUAV propagation channelunmanned aerial vehicle (UAV)

Keywords Plus

TO-GROUND CHANNELPROPAGATION CHANNELRADIO CHANNELBANDMODELMOBILITYSUBURBANSYSTEMSNETWORKPERFORMANCE

Sound

4-A sound-vibration physical-information fusion constraint-guided deep learning method for rolling bearing fault diagnosis

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By You, KS (You, Keshun) [1] ; Wang, PZ (Wang, Puzhou) [1] , [2] ; Huang, P (Huang, Peng) [1] ; Gu, YK (Gu, Yingkui) [1] (provided by Clarivate) **Source RELIABILITY ENGINEERING & SYSTEM SAFETY Volume 253 DOI 10.1016/j.ress.2024.110556 Article Number 110556 Published JAN 2025 Early Access OCT 2024 Indexed 2024-11-06 Document Type Article**

Abstract

Although current deep learning models for bearing fault diagnosis have achieved excellent accuracy, the lack of constraint-guided learning of the physical mechanisms of real bearing failures and a physically scientific training paradigm leads to low interpretability and unreliability of intelligent fault diagnosis models. In this study, a sound-vibration physical-information fusion constraint-guided (PFCG) deep learning (DL) method is proposed, aiming at weighted fusion of sound and vibration multi-physical information into a deep learning model, to guide the DL model to learn more realistic physical laws of bearing failure. Firstly, a 15-degree-of-freedom nonlinear dynamics model of multi-stage degraded bearing failure mechanism with sound-vibration response is developed, which considers the evolutionary mechanism of bearing failure from healthy state to different stages, and utilizes a particle filtering algorithm for dynamic calibration of hidden parameters. Moreover, a lightweight DL fault diagnosis model is designed to realize the deep interaction between the physical model and the DL model through the weighted fusion of the cross-entropy loss function, physical consistency loss and uncertainty loss. Moreover, the superior diagnostic performance of the proposed sound and vibration PFCG-DL model is verified by comparing the performance fluctuations and parameter attributes of different DL benchmark models before and after being guided by physical information fusion constraints (PFCG). Eventually, the proposed PFCGTransformer model achieves a diagnostic accuracy of 99.45% while keeping the number of parameters at only 0.62M, which significantly improves the accuracy and reduces the computational complexity by 81.5% compared to the CAME-Transformer model's 3.24 M number of parameters and 95.00% diagnostic accuracy. In addition, the test time of PFCG-Transformer is reduced to 1.02 s, which is 60.2% less than CAME-Transformer, demonstrating higher computational efficiency and real-time performance. Importantly, in terms of interpretability, the engineering interpretability and credibility of the models are further improved by visualizing the feature learning results of the vibration modal and multimodal fusion models and the sensitivity analyses of the sound-vibration response models with internal and external physical hyperparameters. Therefore, this study proposes a physical information-guided deep learning method with strong interpretability and superior performance, which provides an important reference for further research and application in the field of bearing fault diagnosis.

Keywords

Author Keywords

Sound-vibrationPhysical-information fusion constraint-guidedDeep learningEngineering interpretabilityBearing fault diagnosis

NETWORKS

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5-A novel semi-analytical meshless method for the thickness optimization of porous material distributed on sound barriers

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By Liu, HQ (Liu, Hanqing) [1] ; Wang, FJ (Wang, Fajie) [1] (provided by Clarivate) **Source APPLIED MATHEMATICS LETTERS Volume 147 DOI 10.1016/j.aml.2023.108844 Article Number 108844 Published JAN 2024 Early Access SEP 2023 Indexed 2023-10-19 Document Type Article**

Abstract

This paper presents a novel semi-analytical meshless method to optimize the thickness of porous material distributed on sound barriers, by employing the Burton-Miller-type singular boundary method in conjunction with the method of moving asymptotes. Firstly, the Delany-Bazley-Miki model is utilized to characterize the acoustic property of sound barrier with a porous sound-absorbing material. Then, the sensitivity formula with respect to the thickness of the porous layer is derived based on the analytical computation and the adjoint variable formula, in which the design variable is a thickness parameter distributed between [0,1]. Finally, the optimal thickness distribution is achieved by solving the optimization model using the method of moving asymptotes. Compared to traditional algorithms, the proposed new method is simple, accurate, easy-to program, and free of mesh and integration. Numerical experiments demonstrate the feasibility and effectiveness of the proposed algorithm.

Keywords
Author Keywords
Thickness optimizationSensitivity analysisboundary methodMethod of moving asymptotesSound barriersBurton-Miller-type singular

Keywords Plus
DESIGN

Sound

6-Sentinel Lymph Node Biopsy vs No Axillary Surgery in Patients With Small Breast Cancer and Negative Results on Ultrasonography of Axillary Lymph Nodes The SOUND Randomized Clinical Trial

By Gentilini, OD (Gentilini, Oreste Davide) [1] , [2] ; Botteri, E (Botteri, Edoardo) [3] , [4] ; Sangalli, C (Sangalli, Claudia) [5] ; Galimberti, V (Galimberti, Viviana) [1] ; Porpiglia, M (Porpiglia, Mauro) [6] ; Agresti, R (Agresti, Roberto) [7] ; Luini, A (Luini, Alberto) [1] ; Viale, G (Viale, Giuseppe) [8] , [9] ; Cassano, E (Cassano, Enrico) [10] ; Peradze, N (Peradze, Nickolas) [1] ;
Group Author SOUND Trial Grp (SOUND Trial Grp) (provided by Clarivate) **Source JAMA ONCOLOGY Volume 9 Issue 11 Page 1557-1564 DOI 10.1001/jamaoncol.2023.3759 Published NOV 2023 Early Access SEP 2023 Indexed 2023-10-12 Document Type Article**

Abstract

IMPORTANCE Sentinel lymph node biopsy (SLNB) is the standard of care for axillary node staging of patients with early breast cancer (BC), but its necessity can be questioned since surgery for examination of axillary nodes is not performed with curative intent.

OBJECTIVE To determine whether the omission of axillary surgery is noninferior to SLNB in patients with small BC and a negative result on preoperative axillary lymph node ultrasonography.

DESIGN, SETTING, AND PARTICIPANTS The SOUND (Sentinel Node vs Observation After Axillary Ultra-Sound) trial was a prospective noninferiority phase 3 randomized clinical trial conducted in Italy, Switzerland, Spain, and Chile. A total of 1463 women of any age with BC up to 2 cmand a negative preoperative axillary ultrasonography result were enrolled and randomized between February 6, 2012, and June 30, 2017. Of those, 1405 were included in the intention-to-treat analysis. Data were analyzed from October 10, 2022, to January 13, 2023.

INTERVENTION Eligible patients were randomized on a 1:1 ratio to receive SLNB (SLNB group) or no axillary surgery (no axillary surgery group).

MAIN OUTCOMES AND MEASURES The primary end point of the studywas distant disease-free survival (DDFS) at 5 years, analyzed as intention to treat. Secondary end points were the cumulative incidence of distant recurrences, the cumulative incidence of axillary recurrences, DFS, overall survival (OS), and the adjuvant treatment recommendations.

RESULTS Among 1405 women (median [IQR] age, 60 [52-68] years) included in the intention-to-treat analysis, 708 were randomized to the SLNB group, and 697 were randomized to the no axillary surgery group. Overall, the median (IQR) tumor size was 1.1 (0.8-1.5) cm, and 1234 patients (87.8%) had estrogen receptor-positive ERBB2 (formerly HER2 or HER2/neu), nonoverexpressing BC. In the SLNB group, 97 patients (13.7%) had positive axillary nodes. The median (IQR) follow-up for disease assessment was 5.7 (5.0-6.8) years in the SLNB group and 5.7 (5.0-6.6) years in the no axillary surgery group. Five-year distant DDFS was 97.7% in the SLNB group and 98.0% in the no axillary surgery group (log-rank P =.67; hazard ratio, 0.84; 90% CI, 0.45-1.54; noninferiority P =.02). A total of 12 (1.7%) locoregional relapses, 13 (1.8%) distant metastases, and 21 (3.0%) deaths were observed in the SLNB group, and 11 (1.6%) locoregional relapses, 14 (2.0%) distant metastases, and 18 (2.6%) deaths were observed in the no axillary surgery group.

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CONCLUSIONS AND RELEVANCE In this randomized clinical trial, omission of axillary surgery was noninferior to SLNB in patients with small BC and a negative result on ultrasonography of the axillary lymph nodes. These results suggest that patients with these features can be safely spared any axillary surgery whenever the lack of pathological information does not affect the postoperative treatment plan.

Keywords

Keywords Plus

FOLLOW-UPTHERAPYDISSECTIONWOMENIRRADIATIONRECURRENCETAMOXIFEN