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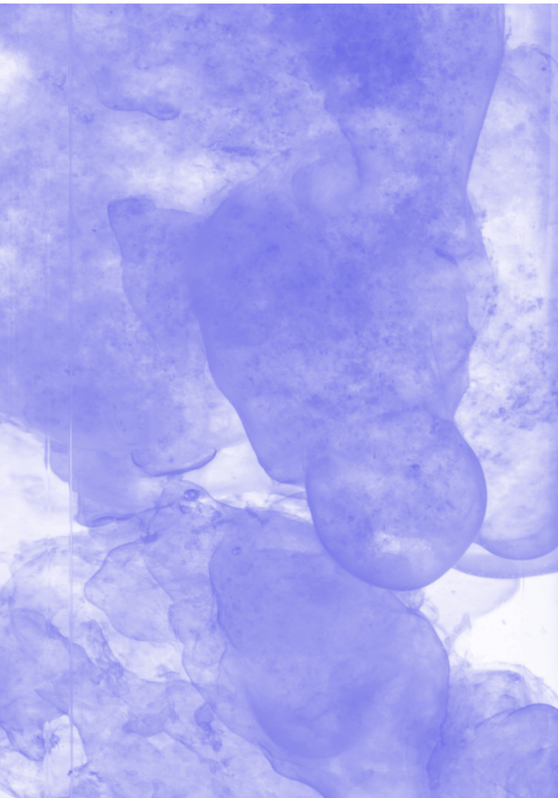

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Section Information

Applied Thermal Engineering is open to receiving high-quality state-of-the-art reviews, original full research, short communications, and case studies, covering all technologies based on heat transfer processes. Therefore, challenging works dealing with applied thermodynamic problems up to real applications are welcomed in this section. Both theoretical and experimental works with rigorous and replicable methodology can be submitted in this section.
Both basic and applied research and anything in between is acceptable in this section, and many different applications can be covered, such as domestic, commercial, industrial, marine, aeronautics, aerospatial, transport, primary/secondary/tertiary sector, and clean energy.

- Heat transfer problems
- Energy conversion
- Combustion
- Cycles
- Mini- and micro-channels
- Heat transfer technologies
- Zero-emission technologies
- 4E analysis

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Prof. Dr. Yuyang Li

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Feature Papers

Thermal Characterization of Phase Change Materials by Differential Scanning Calorimetry: A Review

Authors: Hazhir Fatahi, Jérôme Claverie and Sébastien Poncet

Abstract: The use of phase change materials (PCMs) in thermal energy storage (TES) applications as a system that can fill the gap between the energy supply and demand has sharply increased over recent years. Due to the dependence of the storage capacity in a TES on the transition (mostly solid/liquid) of PCMs, knowing the thermal properties of PCMs is of high importance. Calorimetric methods have an inevitable role in PCMs' characterization methods. The most important properties of PCMs that lead us to integrate them in a specific application can be determined by the calorimetric method. These properties are transition temperatures, the enthalpy of transition and the heat capacity. Among the calorimetric methods, differential scanning calorimetry (DSC) is widely available and accurate results can be obtained at a reasonable cost. Furthermore, the thermal stability of PCMs can be determined after a hundred cycles of melting and solidification. The present work proposes an extensive and comprehensive review on calorimetric measurements of PCMs via the DSC method. The objective is to highlight the relevant research with a focus on DSC characterization of PCMs. This review includes studies from 1999 to 2022 and provides a summary of the methods, results and recommendations for future measurements.

https://doi.org/10.3390/app122312019

Novel Infrared Approach for the Evaluation of Thermofluidic Interactions in a Metallic Flat-Plate Pulsating Heat Pipe

Authors: Luca Pagliarini, Luca Cattani, Maksym Slobodeniuk, Vincent Ayel, Cyril Romestant, Fabio Bozzoli and Sara Rainieri

Abstract: A novel and advanced analysis tool, based on the resolution of the inverse heat conduction problem, is used to evaluate wall-to-fluid heat fluxes in a metallic flat-plate pulsating heat pipe. The device under analysis is made of copper and formed by 16 channels having a squared section of 3 × 3 mm^2 and filled with a water–ethanol mixture (20 wt.% of ethanol) with a volumetric filling ratio of 50%. One flat side of the device is externally coated with a highly emissive paint to perform temperature measurements by means of a medium-wave infrared camera. The acquired infrared maps are first processed by a three-dimensional Gaussian filter and then used as inputs for the inverse approach for the evaluation of heat fluxes locally exchanged between the fluid and the thin walls of each channel. The suggested procedure is successfully validated by means of synthetic data. The resulting space–time heat flux distributions are therefore statistically investigated in terms of amplitude and space–time variations, providing quantitative references for the identification of two-phase flow regimes. These unique data give an evaluation of the local heat transfer behavior, which is essential to provide empirical values for the numerical models of pulsating heat pipes.

https://doi.org/10.3390/app122211682

Sensitivity Analysis for Transient Thermal Problems Using the Complex-Variable Finite Element Method

Authors: Juan-Sebastian Rincon-Tabares, Juan C. Velasquez-Gonzalez, Daniel Ramirez-Tamayo, Arturo Montoya, Harry Millwater and David Restrepo

Abstract: Solving transient heat transfer equations is required to understand the evolution of temperature and heat flux. This physics is highly dependent on the materials and environmental conditions. If these factors change with time and temperature, the process becomes nonlinear and numerical methods are required to predict the thermal response. Numerical tools are even more relevant when the number of parameters influencing the model is large, and it is necessary to isolate the most influential variables. In this regard, sensitivity analysis can be conducted to increase the process understanding and identify those variables. Here, we combine the complex-variable differentiation theory with the finite element formulation for transient heat transfer, allowing one to compute efficient and accurate first-order sensitivities. Although this approach takes advantage of complex algebra to calculate sensitivities, the method is implemented with real-variable solvers, facilitating the application within commercial software. We present this new methodology in a numerical example using the commercial software Abaqus...

https://doi.org/10.3390/app12052738

The Effect of Porous Media on Wave-Induced Sloshing in a Floating Tank

Authors: Wen-Huai Tsao, Ying-Chuan Chen, Christopher E. Kees and Lance Manue

Abstract: Placing porous media in a water tank can change the dynamic characteristics of the sloshing fluid. Its extra damping effect can mitigate sloshing and, thereby, protect the integrity of a liquefied natural gas tank. In addition, the out-of-phase sloshing force enables the water tank to serve as a dynamic vibration absorber for floating structures in the ocean environment. The influence of porous media on wave-induced sloshing fluid in a floating tank and the associated interaction with the substructure in the ambient wave field are the focus of this study. The numerical coupling algorithm includes the potential-based Eulerian–Lagrangian method for fluid simulation and the Newmark time-integration method for rigid-body dynamics. An equivalent mechanical model for the sloshing fluid in a rectangular tank subject to pitch motion is proposed and validated. In this approach, the degrees of freedom modeling of the sloshing fluid can be reduced so the numerical computation is fast and inexpensive. The results of the linear mechanical model and the nonlinear Eulerian–Lagrangian method are correlated. The dynamic interaction between the sloshing fluid and floating body is characterized. The effectiveness of the added porous media in controlling the vibration and mitigating the sloshing response is confirmed through frequency response analysis.

https://doi.org/10.3390/app12115587

Characterization of Nonlinear Responses of Non-Premixed Flames to Low-Frequency Acoustic Excitations

Authors: Deng Pan, Chenzhen Ji and Tong Zhu

Abstract: The response of flames' heat release to acoustic excitation is a critical factor for understanding combustion instability. In the present work, the nonlinear heat release response of a methane–air non-premixed flame to low-frequency acoustic excitations is experimentally investigated. The flame describing function (FDF) was measured based on the overall CH* chemiluminescence intensity and the velocity fluctuations obtained by the two-microphone method. The CH* chemiluminescence and schlieren images were analyzed for revealing the mechanism of nonlinear response. The excitation frequency ranges from 10 Hz to 120 Hz. The forced relative velocity fluctuation amplitude ranges from 0.10 to 0.50. The corresponding flame Strouhal number (St_f) ranges from 0.43 to 4.67. The study has shown that the flame length responds more sensitively to changes in excitation amplitude when subjected to relatively high-frequency excitations. The normalized flame length (L_f/D) decreases from 3.79 to 2.37 with the increase in excitation amplitude at an excitation frequency of 100 Hz. The number of oscillation zones along the flame increases with increasing excitation frequency, which is consistent with the increase in the St_f. The low-pass filtering characteristic of FDF is caused by the dispersion of multiple oscillation zones, as well as the cancellation effect of the adjacent oscillation zones under relatively high-frequency excitation. The main mechanism for the local gain peak and valley is the cancellation effect of positive and negative oscillation zones with various St_f. When two adjacent oscillation regions have similar amplitudes, the overall phase-lag becomes more sensitive to changes in excitation frequency and amplitude. This sensitivity leads to nonlinear anomalous changes in the phase-lag near the frequency corresponding to the gain valley. The calculated disturbance convection time is consistent with the measured time delay in the short flame scenario. Further research is required to determine whether the identified agreement is a result of the consistent occurrence of the oscillation zone in close proximity to the flame's center of mass, in conjunction with a precise determination of the average convective velocity.

https://doi.org/10.3390/app13106237

Invitation to Submit

Novel Research on Heat Transfer and Thermodynamics

Guest Editor: Prof. Dr. Fernando Zenaido Sierra-Espinosa
Deadline: 20 March 2025

Applications of Phase Change Materials in Heat Transport Systems

Guest Editor: Prof. Dr. Haitao Hu
Deadline: 20 April 2025

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