VIETNAM NATIONAL UNIVERSITY, HANOI
VNU UNIVERSITY OF ENGINEERING AND TECHNOLOGY

SOCIALIST REPUBLIC OF VIETNAM
Independence – Freedom – Happiness

INFORMATION ON DOCTORAL THESIS

1. Full name: Pham Dinh Nguyen 2. Sex: Male

3. Date of birth: December 10th, 1995 4. Place of birth: Bac Giang

5. Admission decision number: 1126B/QĐ-CTSV, Dated November 14th, 2018, by the Rector of VNU - University of Engineering and Technology.

6. Changes in academic process:

Decision on extending the study period for two academic years for the doctoral candidate, No. 1400/QĐ-ĐHCN, dated December 30th, 2022, by the Rector of the VNU - University of Engineering and Technology; Decision on adjusting the title of the doctoral dissertation for the doctoral candidate, No. 1472/QĐ-ĐHCN, dated July 19th, 2024, by the Rector of the VNU - University of Engineering and Technology.

7. Official thesis title: ***Nonlinear buckling and dynamic analysis of FG-CNTRC plates and shells***.

8. Major: Engineering Mechanics 9. Code: 9520101.01

10. Supervisors: Full Professor Dr. Sci. Nguyen Dinh Duc

11. Summary of the **new findings** of the thesis:

The main contributions of the thesis include:

- Propose a new sinusoidal shear deformation theory aimed at simplifying the complex calculations involved analyzing FG-CNTRC plates and shells, while still accurately describing the nonlinear relationship between shear stress and strain. This theory will provide equilibrium and motion equations derived from both the proposed sinusoidal shear deformation theory and existing theories, such as Reddy's shear deformation theories. These equations will be based on the virtual work principle and Hamilton's principle, incorporating a von-Kármán nonlinear displacement field.
- Determine three solution forms of displacement and stress functions that correspond to specific boundary conditions for FG-CNTRC plate and shell analysis based on the analytical approach. These boundary conditions include fully simply supported edges, fully clamped-clamped edges, opposite edges simply supported and other edges clamped.

- Establish governing equations for the nonlinear buckling and post-buckling analysis of FG-CNTRC plates, double curved shells, and truncated conical shells to determine the critical buckling load and the load-deflection relationship employed both analytical and numerical approaches.
- Establish a 3D finite element model in ABAQUS using user-defined subprogram USDFLD to simulate the functionally graded distribution of CNTs along the thickness. This model will then be utilized to analyze the buckling behavior of FG-CNTRC plates and shells.
- Establish governing equations to determine natural frequencies, deflection amplitude-time relationships, deflection amplitude-frequency relationships in the nonlinear vibration and dynamic analysis of FG-CNTRC plates, double curved shells, and truncated conical shells.

12. Practical applicability:

Nonlinear buckling and dynamic analysis of FG-CNTRC plates and shells using analytical, semi-analytical, and finite element methods provide results on critical loads, load-deflection curves, natural frequencies, deflection amplitudes, and time responses. These results help to understand how FG-CNTRC structures respond under static and dynamic loading in real conditions. This contributes to providing support solutions in the design and non-destructive diagnosis process, as well as enhancing the performance of functionally graded carbon nanotube reinforced composite plates and shells.

13. Further research directions:

- Analyze the static and dynamic problems of FG-CNTRC plates and shells using various methods such as Navier solution and Fourier transform to determine closed-form solutions of the equations.
- Optimize CNT's volume fraction to enhance performance as well as critical loads and natural frequencies of FG-CNTRC structures.
- Use experimental, analytical, numerical simulation methods combined with machine learning in the mechanical analysis of FG-CNTRC structures.
- Develop a model to determine the material properties of FG-CNT using the Representative volume element method combined with artificial neural network modeling.

14. Thesis-related publications:

[CT1]. **Pham Dinh Nguyen**, Nguyen Dinh Duc (2024), "A semi-analytical sinusoidal shear deformation theory for nonlinear dynamic response and vibration of CNT–FGM doubly curved shallow shells", *Acta Mechanica*, DOI:

https://doi.org/10.1007/s00707- 023-03824-8. (Springer, SCI, Nature Index, IF= 2.166).

[CT2]. **Pham Dinh Nguyen**, Do Thi Thu Ha, Duong Manh Tuan (2023). Static Buckling and Free Vibration Analysis of Aligned CNTs Reinforced Composite Plates. VNU Journal of Science: Mathematics - Physics, [S.l.], v. 39, n. 4, dec. 2023. DOI: https://doi.org/10.25073/2588-1124/vnumap.4876.

[CT3]. **Pham Dinh Nguyen**, George Papazafeiropoulos, Quang-Viet Vu, Nguyen Dinh Duc (2022), "Buckling response of laminated FG-CNT reinforced composite plates: analytical and finite element approach", *Aerospace Science and Technology*, Vol. 121, 107368 (Elsevier, SCIE, IF=5.457).

[CT5]. Nguyen Dinh Duc, Duong Tuan Manh, Nguyen Dinh Khoa, **Pham Dinh Nguyen** (2022), "Mechanical stability of sandwich eccentrically stiffened auxetic truncated conical shells surrounded on elastic foundations", *Mechanics of Composite Materials*, Vol. 58, pp. 365–382 (Springer, SCIE, IF=1.52).

[CT6]. Nguyễn Đình Đức, **Phạm Đình Nguyện*** (2021), "Tối ưu vị trí gân trong phân tích ổn định của tấm composite nhiều lớp", *Đã đăng tại tuyển tập hội nghị Hội nghị Khoa học toàn quốc Cơ học Vật rắn lần thứ XV, 6-7/8/2021*.

[CT7]. **Pham Dinh Nguyen**, George Papazafeiropoulos, Quang-Viet Vu, Nguyen Dinh Duc (2021), "Optimum buckling analysis of laminated composite plates reinforced by multiple stiffeners", *The 6th International Conference on Engineering Mechanics and Automation (ICEMA 2021).*

[CT8]. Vu Thi Thuy Anh, Vu Thi Huong, **Pham Dinh Nguyen**, Nguyen Dinh Duc (2021), "Nonlinear dynamic analysis of porous graphene platelet-reinforced composite sandwich shallow spherical shells", *Mechanics of Composite Materials*, Vol. 57 (5), pp. 609-622 (Springer, SCIE, IF=1.52).

[CT9]. **Pham Dinh Nguyen**, Quang-Viet Vu, George Papazafeiropoulos, Hoang Thi Thiem, Pham Minh Vuong, Nguyen Dinh Duc (2020), "Optimization of laminated composite plates for maximum biaxial buckling load", *VNU Journal of Science: Mathematics - Physics*, Vol. 121, DOI: 10.25073/2588-1124/vnumap.4509

[CT10]. Duong Tuan Manh, Vu Thi Thuy Anh, **Pham Dinh Nguyen**, Nguyen Dinh Duc (2020), "Nonlinear post-buckling of CNTs reinforced sandwich-structured composite annular spherical shells", *International Journal of Structural Stability and Dynamics*, Vol. 20 (02), pp. 2050018.

[CT3]. **Pham Dinh Nguyen**, Vu Dinh Quang, Vu Thi Thuy Anh, Nguyen Dinh Duc (2019), "Nonlinear vibration of carbon nanotube reinforced composite truncated conical shells in thermal environment", *International Journal of Structural Stability and Dynamics*, Vol. 19 (02), pp. 1950158 (World Scientific, SCIE, IF=2.015).

[CT11]. Do Quang Chan, **Pham Dinh Nguyen**, Vu Dinh Quang, Vu Thi Thuy Anh, Nguyen Dinh Duc (2019), "Nonlinear buckling and post-buckling of functionally graded carbon nanotubes reinforced composite truncated conical shells subjected to axial load", *Steel and Composite Structures*, Vol. 31 (3), pp .243-259.

[CT12]. Ngo Dinh Dat, Nguyen Dinh Khoa, **Pham Dinh Nguyen**, Nguyen Dinh Duc (2019), "An analytical solution for nonlinear dynamic response and vibration of FG-CNT reinforced nanocomposite elliptical cylindrical shells resting on elastic foundations", *ZAMM - Zeitschrift fuer Angewandte Mathematik und Mechanik*, Vol. 100, DOI: 10.1002/zamm.201800238 (WILEY, SCIE, IF= 1.467).

[CT13]. Nguyen Dinh Khoa, **Pham Dinh Nguyen** (2019), "Analytical investigation on nonlinear dynamic behavior and free vibration analysis of laminated nanocomposite plates", *Proc ImechE Part C J Mech Eng Sci,* Vol. 233, pp. 6866-6878.

[CT14]. Nguyen Dinh Duc, **Pham Dinh Nguyen**, Nguyen Huy Cuong, Nguyen Van Sy, Nguyen Dinh Khoa (2018), "An analytical approach on nonlinear mechanical and thermal post-buckling of nanocomposite double-curved shallow shells reinforced by carbon nanotubes", *Journal of Mechanical Engineering Science*, Vol. 233 (11), pp. 3888-3903. Doi: 10.1177/0954406218802921 (SAGE, SCIE, IF=1.015).

Date: July 23rd, 2024

Full Prof. Dr. Sci. Nguyen Dinh Duc

Date: July 23rd, 2024

Pham Dinh Nguyen