COLLEGE OF ENGINEERING AND COMPUTER SCIENCE
FLORIDA ATLANTIC UNIVERSITY

Announces the Ph.D. Dissertation Defense of

Mahyar Ghazvini

for the degree of Doctor of Philosophy (Ph.D.)

"Understanding Bubble Growth Behavior during Nucleate Boiling"

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ABSTRACT OF DISSERTATION
Understanding Bubble Growth Behavior during Nucleate Boiling

Boiling heat transfer associated with bubble growth is perhaps one of the most efficient cooling methodologies due to its sizeable latent heat during phase change. Despite significant advancement, numerous questions remain regarding the fundamentals of bubble growth mechanisms, a primary source of enhanced heat dissipation. This thesis provides a comprehensive examination of the mechanisms involved in the growth of bubbles during nucleate boiling. By conducting a combination of experiments and numerical analyses, the goal is to enhance our understanding of bubble growth phenomena and their impact on heat transfer. Initially, the experimental work focuses on comparing the heat transfer performance and parameters related to bubble dynamics between regular and modified fin structures. The findings demonstrate that the modified fin structure, which featured artificial nucleation sites, exhibits superior heat transfer characteristics. This improvement is attributed to changes in the bubble departure diameter, bubble departure frequency, and growth time. Subsequently, an artificial neural network is developed to accurately predict the bubble departure diameter based on the wall superheat and subcooling level. This predictive model provides valuable insights into bubble behavior originating from artificial nucleation sites. Furthermore, experiments utilizing dual tracer laser-induced fluorescence thermometry technique enable precise measurements of three-dimensional, space- and time-resolved liquid temperature distributions surrounding growing bubbles. The results unveil transient temperature variations during bubble growth and departure, underscoring the role of the growing bubble as a heat remover from the

surface. Additionally, the influence of surface orientation on bubble dynamics and heat transfer is investigated, shedding light on how different orientations affect the bubble departure diameter and frequency. Finally, a numerical investigation using ANSYS FLUENT is conducted to comprehend bubble initiation and growth on both horizontal and vertical heated surfaces. The simulation results aligned well with the experimental data, further contributing to our understanding of bubble growth mechanisms in nucleate boiling. Overall, these studies deepen our knowledge of bubble growth mechanisms and their implications in nucleate boiling.

BIOGRAPHICAL SKETCH
Born in Iran
B.S., Shahrood University of Technology, Shahrood, Iran, 2008-2013
M.S., University of Tehran, Tehran, Iran, 2014-2017
Ph.D., Florida Atlantic University, Boca Raton, Florida, 2020-2023

CONCERNING PERIOD OF PREPARATION
& QUALIFYING EXAMINATION

Time in Preparation: 2020-2021

Qualifying Examination Passed: Fall 2021

Published Papers:

- Mahyar Ghazvini, Mazen Hafez, Abel Abraham, Cristian Pena, Myeongsub Kim. Investigation of Heat Transfer near a Growing Bubble during Nucleate Boiling using Dual-Tracer Laser-Induced Fluorescence Thermometry (Ready to submit)
- Mahyar Ghazvini, Mazen Hafez, Philippe Mandin , Myeongsub Kim. Experimental Study of Pool Boiling Heat Transfer on Novel Fin Surfaces (International Journal of Multiphae Flow). 2023.
- M. Ghazvini, M, Hafez, A, Ratanpara, M, Kim. A Review on Correlations of Bubble Growth Mechanisms and Bubble Dynamics Parameters in Nucleate Boiling, Journal of Thermal Analysis and Calorimetry, 2021.
- Mahyar Ghazvini, Seyyed Mojtaba Varedi-Koulaei, Mohammad Hossein Ahmadi, Myeongsub Kim. Optimization of MLP neural network for modeling flow boiling performance of Al2O3/water nanofluids in a horizontal tube. Engineering Analysis with Boundary Elements, 2022.
- Mahyar Ghazvini, Mohammadhassan Kavosi, Rohan Sharma, Myeongsub Kim. A review on mechanical-based microalgae harvesting methods for biofuel production. Biomass and Bioenergy. 2022.
- Mazen Hafez, Mahyar Ghazvini, Myeongsub Kim, On the Stability of Particle–Particle Interaction during Gravitational Settling, *Energies* 2022.