MicroTAS 2021 Workshop 7 Information

WORKSHOP TITLE: Machine Learning for Microfluidic Design and Automation

PRESENTER AFFILIATION:

Yoonjin Won, University of California, Irvine, USA (https://www.won.eng.uci.edu/) - Data-driven transport and materials design using machine learning models
Tsung-Yi Ho, National Tsing Hua University, Taiwan - Design automation for digital microfluidic biochips using machine learning
Junchao Wang, Hangzhou Dianzi University, China (http://orcid.org/0000-0002-6749-1858) - Machine learning in microfluidic circuit design

WORKSHOP DESCRIPTION:

Microfluidics or Lab on a Chip (LoC) system provides a powerful integrated platform for automated manipulation of different solutes, droplets, particles or even tissue at the microscale. Unlike conventional microfluidic devices, current LoC systems usually have multiple units with various functionalities, which requires microfluidic-oriented design automation tools to facilitate researchers during the design process. To address this issue, machine learning techniques might be a promising solution for microfluidics/LoC design automation with its ability to learn from both experimental data and numerical data. In this workshop, different aspects related to this field will be presented and discussed.

OVERVIEW OF MATERIAL TO BE COVERED AND WHAT ATTENDEES CAN EXPECT TO TAKE AWAY FROM THE WORKSHOP:

This workshop will include 3 lectures:

Lecture 1

Yoonjin Won, University of California, Irvine, USA ; won@uci.edu

The first introductory lecture will focus on investigating fundamental insights into nanoscale interfacial and transport physics, centering on keywords—data-driven approach, machine learning models, extreme computing, and materials design. In this workshop, Dr. Won will discuss 1) how to extract features using machine learning image analysis and 2) how to use

those features to evaluate their materials properties and thermal performances.

Lecture 2

Tsung-Yi Ho, National Tsing Hua University, Taiwan; tyho@cs.nthu.edu.tw

The second lecture will focus on ElectroWetting-On-Dielectric (EWOD) microfluidic biochips. We cast droplet transportation as a Reinforcement Learning (RL) problem enables the training of deep network policies to capture the underlying health conditions of electrodes and provide reliable fluidic operations for various sizes of EWOD microfluidic biochips. We will demonstrate a simulation environment based on the OpenAI Gym Interface for RL-guided droplet-routing problems on EWOD microfluidic biochips.

Lecture 3

Junchao Wang, Hangzhou Dianzi University, China; junchao@hdu.edu.cn

The third lecture will focus on 1) using MATLAB to automate the simulation process with COMSOL Multiphysics to generate the data for machine learning; 2) demonstrating an example of machine learning-aided design by transforming the fluid mechanics problem into an image recognition problem and using a convolutional neural network-based technique to predict the fluid behavior of random microfluidic mixers; 3) presenting a computer vision-based method for rapid and precise 3D printing calibration for microfluidic devices.

WHO SHOULD ATTEND:

This workshop would provide an overview on how to applying machine learning techniques on microfluidic design and automation:

- graduate students and post-docs working in computer aided design or design automation of microfluidics and Lab on a Chip.
- Academic researchers.
- Representatives from the industry.

PARTICIPANTS WILL NEED THE FOLLOWING:

Laptop with MATLAB, COMSOL, PYTHON, OpenAI Gym.

For those attending in-person, a laptop or iPad with headphones are required.