

# Curriculum Vitae

## Personal Information

Harikrishnan Narayanan Unni (H.N.Unni)

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## Address

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**ASSISTANT PROFESSOR**, Department of Biomedical Engineering, Indian Institute of Technology, Hyderabad (2012 - )

## PROFESSIONAL EXPERIENCE (2006 – 2012)

**Post Doctoral Research** (Project Lead): National University of Singapore

Research Field: **Lab on a Chip – Microfluidics and Multiscale - Multistage integration**

**Research Project (Funded by Singapore National Research Foundation (NRF))**: A Multistage-Multiscale-Multidisciplinary approach based on Integrated Acoustic Streaming, Dielectrophoresis and Microbiological Studies for Rapid Detection of Microbial Contamination in Water

**Post Doctoral Research**: Nanyang Technological University, Singapore

Research Field: **Microfluidic transport in Lab-on-a-Chip devices**

Principal Investigator: Prof. Liu Ai Qun

## ACADEMIC QUALIFICATIONS

**PhD**: Nanyang Technological University, Singapore 2002 - 2006

Advisor: Prof. Yang Chun, Charles

Thesis: **Transport and Deposition of Colloidal Particles in Microchannel Flow**

**M.E**: National Institute of Technology (REC), Trichy, India 1999 – 2001

CGPA = **9.75/10 (Ranked 1st/12)**

Specialization: Fluid Mechanics, Heat Transfer, Machine Design

Thesis: Optimization of axial flow fan analysis

**B.Tech**: Calicut University, Kerala, India 1994 - 1998

Major: Mechanical Engineering Class: Distinction (Honors) – **76.71%**

## Research interests

- Continuum Modeling of microscale and macroscale fluid mechanics and particle transport
- Single and Multilayer microfluidic fabrication (Lithography and Etching) and Nanofabrication (Nano-imprint Lithography)
- Mesoscale and nanoscale simulation of complex fluids using stochastic techniques (Brownian dynamics simulation and Dissipative particle dynamics)
- Computational investigation (Boundary collocation and Boundary element methods) of multiphase interface flows
- Fluid-Structure interactions

## Professional experience

### Postdoctoral research: (2006-till date)

- Led a **Singapore National Research Foundation (NRF) funded project (SGD 2 million)** on the development of a Multi-Scale (Milli-Micro-Nano) system incorporating networks of Acoustic Concentrators (milli scale) for continuous bacterial cell concentration, Dielectrophoretic Chips (micro scale) for continuous cell trapping and antibody (nanodot) tagged cell detection.
- Performed numerical and experimental studies on the continuous acoustic concentration and separation of bacterial cells (based on Acoustic radiation force – Flow field interaction), *Cryptosporidium Parvum* and *Giardia Lambia* in an L-shaped aluminium chamber fitted with a piezo-electric transducer.
- Performed On-chip characterization and separation of pathogens *Cryptosporidium Parvum* and *Giardia Lambia* using a microfluidic Dielectrophoretic chip employing ITO (Indium Tin Oxide)-PDMS bonding.
- Integrated a flow network consisting of 7 Acoustic chambers (in a 4–2-1 arrangement), 2 DEP chips (with 4- level branched structures), pumps and fluorescent antibody inlets to develop a continuous pathogen monitoring system from 500ml of sample water.
- Performed theoretical investigation of the effects of interface instabilities at fluid flow interfaces in microfluidic and optofluidic systems by employing analytical models, non-linear stochastic hydrodynamic equations and time-dependent density functional theory.
- Prepared several research proposals for National Research Foundation, Singapore and A\*STAR (Agency of Science, Technology and Research), Singapore and Organized international workshops and conferences in Singapore

**Ph.D : Nanyang Technological University, Singapore (2002-2006)**

- Developed a numerical model (convection-diffusion) for computing particle transport and deposition in parallel plate microchannels and performed simulations to study particle deposition under various physicochemical conditions.
- Developed a stochastic simulation (Brownian Dynamics Simulation) code for modeling the particle transport and deposition in microfluidic devices and simulated the effect of particle interactions on transport and deposition in microchannels.
- Performed an analytical-numerical study on multiparticle (spheres) electrophoresis in parallel plate microchannels and developed a mathematical model for analytical evaluation of particle velocities in microchannels. The perturbations to be potential field and flow field were analytically formulated using Spherical harmonic functions and Fourier integrals and particle velocities were computed using Boundary collocation method.
- Designed and fabricated a microfluidic cell for performing videomicroscopic experiments in electrokinetic flow. Conducted videomicroscopic experiments for particle imaging and quantifying particle deposition.
- Conducted Lab Assistance Sessions for undergraduate students (Heat Exchanger performance evaluation).

**Awards and prizes**

1. IES Prestigious Engineering Awards, 2006
2. GATE (Graduate Aptitude Test in Engineering) Scholarship (94.78%)

**Computer Skills**

- Microsoft Windows 2000/XP/Vista/7
- C, C++, MATLAB, MATHEMATICA, FORTRAN 90, CFD-ACE+, COMSOL MULTIPHYSICS, ANSYS, SIGMAPLOT, IMAGEPRO

## PUBLICATIONS

### Book Chapter

**Harikrishnan N. Unni** and Chun Yang, Deposition of colloidal particles from electrokinetic flow suspension in microfluidic channel, **Biofouling: Types, Impact and Anti-Fouling**, Nova Science Publishers, pp. 271-293 (2009).

### Journal

1. **Harikrishnan Narayanan Unni\***, Deny Hartono, Lin Yue Lanry Yung, Mary Mah-Lee Ng, Heow Pueh Lee, Boo Cheong Khoo and Kian Meng-Lim, Characterization and Separation of Cryptosporidium and Giardia Cells using On-chip Dielectrophoresis, **Biomicrofluidics**, 06, 012805 (2012).

(The above article was selected by the **Virtual Journal of Biological Physics Research**, American Institute of Physics, Vol.23, Issue 6, 2012).

2. **Harikrishnan Narayanan Unni\***, Deny Hartono, Kian-Meng Lim, On-Chip Trapping and Characterization of Cryptosporidium Using Surface Coated ITO-PDMS Bonded Chips, **Advanced Materials Research**, Vol. 254, pp. 191-194 (2011).

3. **Unni HN**, Yang C., Colloidal particle deposition from electrokinetic flow in a microchannel, **Electrophoresis**, Vol. 30, 5, pp.732-741 (2009).

4. **H.N. Unni**, C. Yang, Kinetics of colloidal particle deposition to a solid surface from pressure driven microchannel flows, **Canadian Journal of Chemical Engineering**, Vol. 85, 5, pp 609-616 (2007).

5. **H.N.Unni**, H.J. Keh and C.Yang, Analysis of Electrokinetic transport in a microchannel, **Electrophoresis**, Vol. 28, pp 658-664 (2007).

6. **H.N.Unni and C.Yang**, Brownian dynamic simulation and experimental study of particle deposition in a microchannel flow. **Journal of Colloid and Interface Science**, Vol. 291, pp. 28-36 (2005).

## Conference

1. **Harikrishnan Narayanan Unni\***, Deny Hartono, Kian-Meng Lim, On-Chip Trapping and Characterization of Cryptosporidium Using Surface Coated ITO-PDMS Bonded Chips, **International Conference on Materials and Advanced Technologies (ICMAT)**, June 26 – July 01, 2011, Singapore.
2. **Harikrishnan Narayanan Unni\***, Deny Hartono, Kian-Meng Lim, On-chip characterization of Cryptosporidium using Dielectrophoresis, **International Conference on Advances in Microfluidics and Nanofluidics (AMN)**, January 05 – 07, 2011, Singapore.
3. **H. N. Unni and Chun Yang**, Kinetics of colloidal particle deposition from electrokinetic microfluidics flows, **7th International Conference on Nanochannels, Microchannels and Minichannels**, June 22-24, Pohang, South Korea.
4. Z. G. Li, L. K. Chin, H. J. Huang, **H. N. Unni** and A. Q. Liu, On-chip liquid tunable grating using laminar microfluidic control system, **12<sup>th</sup> International conference on miniaturized systems for chemistry and life sciences (MicroTAS 2008)**, San Diego, USA.
5. **H.N.Unni**, C.Yang and A.Q.Liu, Colloidal Particle Immobilization in Microchannel Electrokinetic Flow under Controlled Conditions, **Third Asia-Pacific Conference of Transducers and Micro-Nano Technology (APCOT 2006)**, scheduled at the Marina Mandarin Hotel, Singapore on June 25 – 28, 2006.
6. **H.N Unni** and C. Yang, “Deposition of colloidal particles from pressure driven microfluidic flow – Brownian Dynamics Simulation”, **International Conference on Computational Methods**, December 15-17, 2004, Singapore.

## References

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- 1.** Dr. Yang Chun, Charles, Associate Professor  
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- 2.** Dr. Liu Ai Qun, Professor  
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- 3.** Dr. Murukeshan Vadakke Matham, Associate Professor  
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