A pocket guide to nanoHUB
2013

Timothy Fisher
Purdue
nanoHUB: An open access gateway

2013

Activities on
http://nanoHUB.org
in 172 countries

- New Registrations
- Simulation Users
- Tutorial / Lecture Users

Over 13,000 / 281,000 Users Annually

nanoHUB.org usage 2013-02-01 00:00:00
People often wonder...

- What is the overall vision of nanoHUB?
- How do we measure “success” in an open access environment?
- What can I find on nanoHUB?
- How can I measure my impact in this open community?
- How do I join? What does it cost?
Vision:

Funding renewed in 2012 for 5+5 years

Over 13,000 / 281,000 Users Annually
Vision: online society
where researchers, developers, educators, industry practitioners, students, and publishers work together in new ways to continuously define new standards of learning and research and spawn new economic endeavors that accelerate the transition of nanoscience to nanotechnology.

Over 13,000 / 281,000 Users Annually
Vision: online society

where researchers, developers, educators, industry practitioners, students, and publishers work together in new ways to continuously define new standards of learning and research and spawn new economic endeavors that accelerate the transition of nanoscience to nanotechnology.
Vision: to create an energized, growing online society where researchers, developers, educators, industry practitioners, students, and publishers work together in new ways to continuously define new standards of learning and research and spawn new economic endeavors that accelerate the transition of nanoscience to nanotechnology.
Vision:

online society

where researchers, developers, educators, industry practitioners, students, and publishers work together in new ways to continuously define new standards of learning and research and spawn new economic endeavors that accelerate the transition of nanoscience to nanotechnology.
Vision: to create an energized, growing online society where researchers, developers, educators, industry practitioners, students, and publishers work together in new ways to continuously define new standards of learning and research and spawn new economic endeavors that accelerate the transition of nanoscience to nanotechnology.

Over 13,000 / 281,000 Users Annually
Vision:

growing online society where researchers, developers, educators, students, and industry practitioners work together in new ways to continuously define new standards of learning and research and spawn new economic endeavors that accelerate the transition of nanoscience to nanotechnology.

Interactive lectures

Over 13,000 / 281,000 Users Annually
Vision:

to create an energized, growing online society
where researchers, developers, educators, industry practitioners, students, and publishers
work together in new ways
to continuously define new standards of learning and research and spawn new economic endeavors that accelerate the transition of nanoscience to nanotechnology.
People often wonder...

- How do we measure “success” in an open access environment?

By automatically assessing user behavior!!!
Usage Patterns

=> Tool Qualification
Education and Research are coupled! all tools!
Time-evolution of nanoHUB tools
Time-evolution of nanoHUB tools
Time-evolution of nanoHUB tools

235 tools!
Time-evolution of nanoHUB tools
The Essence of a Research University

Education and Research are coupled!
People often wonder...

- What can I find on nanoHUB?

Whatever this open community (including you) is willing to share!!!
Exploring on the home page
Exploring using the menu

- Courses
- Presentation Materials
- Tools
>80 Courses - browse visually

https://nanohub.org/resources/courses
ECE 606: Principles of Semiconductor Devices

In the last 50 years, solid state devices like transistors have evolved from an interesting laboratory experiment to a technology with applications in all aspects of modern life. Making transistors is a complex process that requires unprecedented ...
ECE 695A Reliability Physics of Nanotransistors

By Muhammad Alam

Electrical and Computer Engineering, Purdue University, West Lafayette, IN

Abstract
This course will focus on the physics of reliability of small semiconductor devices. In traditional courses on device physics, the students learn how to compute current through a device when a voltage is applied. However, as transistors are turned on and off trillions of times during the years of the operation, gradually defects accumulate within the device so that at some point the transistor does not work anymore. The course will explore the physics and mathematics regarding how and when things break – a topic of great interest to semiconductor industry.
ECE 695A Reliability Physics of Nanotransistors

By Muhammad Alam

Electrical and Computer Engineering, Purdue University, West Lafayette, IN

Kalyan K  08:55 PM  20 Jun, 2013

5.0 out of 5 stars  ★★★★★

Most useful course, searching for something like all my professional career. Thank you Dr. Alam
Structured online education
nanoHUB.org

• 5 week nano courses  
  • Free in self paced
• Badges awarded
• Accessible anywhere
• Shortened lecture format
• Interactive discussions
• Simulation powered

Over 3,000 worldwide students
Tools - browse visually

nanohub.org/resources/tools?view=taxonomy
Crystal Viewer Tool

This is a tool to view various Bravais Lattices, planes in crystal, lattice vectors, miller indices.

Developer:
Abhijeet Paul.

Press Simulate to view results for the input parameters on the left.
Goals:
- High ON current (high drive)
- Low OFF current (low loss)
- Fast switching

Experimental Approaches:
- Reduce device size
- Strain engineering
- New materials (III-V materials)

Experimental Problem:
- OFF Current too high

Experiments:
D.H. Kim et al, IEDM 07, EDL 08
High Current Regime

\[ V_g = 0.05 \text{ V} \]
Include Rounded Corners and Gate Tunneling => Match Experimental Data

- Match experimental data
- Provide metrology
- Begin to guide experiment
- Share code with experimental group
OMENwire (running OMEN on 80-256 cores)

Device Type

Class: Circular Nanowire
Online Presentations

Resources: Online Presentations

Sort by Title

Computational Mathematics: Role, Impact, Challenges

This presentation was one of 13 presentations in the one-day forum, "Excellence in Computer Simulation," which brought together a broad set of experts to reflect on the future of computational science and engineering. Learn more.

View Presentation (SWF)

What is this? About NCN Supported

Explore Resources

Top Rated

ME 597 Lecture 17: Cantilever Eigenmodes, Equivalent Point Mass Oscillator, Analytical Approaches
29 Dec 2010 Online Presentations Contributor(s): Arvind Raman

RANKING

The following are top-rated resources of this type.
Three Computational Grand Challenges Projects

- Confined water
- Diamond under pressure
- The Structure of Boron

- Three different problems that require a first-principles description and large scale computing
Lectures on 3D Technologies

New Dimensions in Performance
Harnessing 3D Integration Technologies

Kerry Bernstein
IBM T.J. Watson Research Center
Yorktown Heights, NY

4 October, 2007
Lafayette, IN

“Escher Envy” courtesy of David Bryant
Nanoscale Electrothermal Energy Transport by: Ali Shakouri

Non uniform temperature in CPUs (central processing units)

- Leakage power exponential increase with temperature
  - Potential thermal runaway

- Lifetime exponential decrease with temperature
  - ($\Delta T=15^\circ C \rightarrow \frac{1}{4}$ lifetime)


http://masc.cse.ucsc.edu
People often wonder...

- How can I measure my impact in this open community?

It starts with contributing something....
What’s my impact as an author?

Gerhard Klimeck

Organization: Purdue University

Employment Status: University / College Faculty

Web Site: https://engineering.purdue.edu/gekcogrp

Biography:
Gerhard Klimeck is the Director of the Network for Computational Nanotechnology at Purdue University and a Professor of Electrical and Computer Engineering. He guides the technical developments and strategies of nanoHUB.org which served over 230,000 users worldwide with on-line simulation, tutorials, and seminars in the year 2012. He was the Technical Group Supervisor of the High Performance Computing Group and a Principal Scientist at the NASA Jet Propulsion Laboratory. Previously he was a member of technical staff at the Central Research Lab of Texas Instruments where he served as manager and principal architect of the Nanoelectronic Modeling (NEMO 1-D) program. NEMO 1-D was the first quantitative simulation tool for resonant tunneling diodes and 1D heterostructures. At JPL and Purdue Gerhard developed the Nanoelectronic Modeling tool (NEMO 3-D) for multimillion atom simulations. NEMO 3-D has been used to quantitatively model optical properties of self-assembled quantum dots, disordered Si/SiGe systems, and single impurities in Silicon. Both tools are based on the representation of the nanoelectronic device with atomistic empirical tight-binding. Quantitative device modeling was demonstrated without any material parameter adjustments, just by entry of geometrical structure parameters. At Purdue his group is developing a new simulation...
Users of Simulation Tools Authored by Gerhard Klimeck (27,852 Users)

- Monthly Users
- Cumulative Users

Graph shows the increase in monthly and cumulative users from 2004 to 2013.
Usage: Overview

Show data for: [Jul 2012 – Jun 2013] View

Table 1: User statistics

<table>
<thead>
<tr>
<th>Users</th>
<th>Totals</th>
<th>Residence</th>
<th>Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Identified</td>
<td>US</td>
<td>Asia</td>
</tr>
<tr>
<td>Total Users</td>
<td>263,897</td>
<td>247,294</td>
<td>26%</td>
</tr>
<tr>
<td>Simulation Users</td>
<td>12,433</td>
<td>4,922</td>
<td>46%</td>
</tr>
<tr>
<td>Interactive Users</td>
<td>60,619</td>
<td>56,554</td>
<td>34%</td>
</tr>
<tr>
<td>Download Users</td>
<td>237,041</td>
<td>235,099</td>
<td>27%</td>
</tr>
</tbody>
</table>
• Come visit us for our 2:00PM hands on workshop