MATLAB in Academia

Examples of success

Alex Tarchini
Gareth Thomas
MathWorks goal:
Change the world by accelerating the pace of discovery, innovation, development, and learning in engineering and science.
Cleve Moler awarded the IEEE 2014 John von Neumann medal for his fundamental and widely used contributions to numerical linear algebra and scientific engineering software that transformed computational science.

Today, through the deployment of MATLAB at many schools around the globe, MathWorks provides MATLAB to over 3 million people every year.

MathWorks goal: Change the world by accelerating the pace of discovery, innovation, development, and learning in engineering and science.
As concert halls for orchestras, MATLAB is part of the scientific infrastructure of academic and research organizations.
MATLAB is neither the music, nor the instrument, nor the musician. It is the space where a musician, together with other musicians, creates, refines, performs, shares and enjoys music.
So, what should musicians be given?

- Enough seats
- The right instruments
- A standard notation in a standard system
- Seamless integration, interface, communication
- Easy access
- Education and training
So, what should the academics be given?

- Enough licenses
- The right toolboxes
- A standard language in a standard operating system
- Seamless integration, interface, communication
- Easy access
- Education and training
We are focused on secondary education.

Dr. D. Cuartielles, CEO at Arduino Verkstad
## Pre-University Engineering

### Early introduction of simulation tools

### CDIO-like approach to problem solving

| Age | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 21 | 22 | 23 |
|-----|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|
| France |  |  |  |  |  |  |  |  |  | ST/ID | CPGE | Université - Grand École |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  | SLES | Université - Facultés |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  | Vœu Professionnel | STS | Licence PE/MP (Master Professionnel) |  |  |  |  |
| Germany |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Italy |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| UK |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Sweden |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Denmark |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Norway |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Finland |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

### Computing at your fingertips

Connecting GCSE students, teachers, schools and industry

MATLAB EXPO 2014
Lycee and classe preparatoire curriculum support

**Content:** Getting started with
- MATLAB
- Simulink
- Simscape
- Stateflow
- SimMechanics
- SimHydraulics
- SimElectronics
- Control design tools

**Audience:**
Lycee and prepa Teachers (STI2D, SI)
Engineering students

**FREE BOOK:**
Physical Modeling and Simulation of Multi-domain Systems

**Author:** Ivan Liebgott,
Teacher of Engineering Science (SI) in preparatory classes

**Available at:**
MATLAB Central File Exchange

**Models of Classroom Applications**
## Rome Maker Faire 2014

<table>
<thead>
<tr>
<th>Category</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visitors</td>
<td>90,000</td>
</tr>
<tr>
<td>Inventions</td>
<td>600</td>
</tr>
<tr>
<td>Workshops</td>
<td>360</td>
</tr>
<tr>
<td>Countries</td>
<td>33</td>
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</tbody>
</table>
The Rise of Low-Cost Hardware for the Masses

Arduino
- 300,000+ commercially produced
- Prices ~$30

Raspberry Pi
- 3 million shipped
- $35

LEGO Mindstorms EV3
- $350

Hardware support packages
mathworks.com/hardware
- Get connected and running quickly
- 150 packages today, for Arduino, RaspPi, iPhone, webcams, Kinect, and more
- For MATLAB and Simulink
Problem to Solve

I need to get more money for my Research!

Have you been to industry?

Yes, but they will only invest if they get return on my research

So what Technology Readiness Level is your research?

Let me explain…

Technology Readiness Level?
Technology Readiness Levels

What does LinkedIn tell us?
What did we see?

- According to LinkedIn’s database MATLAB is a key skill that people advertise to get jobs after University

- Having a unique software platform which can be used at ANY Technology Readiness Level helps Connect Academia to Industry

Wow.. That LinkedIn Tool was great … Can you show me again…”
What does LinkedIn tell us?
Basic Principles

Proof of Concept

Proven Field Operation

MOOCs

Secondary

Makers

UNIVERSITY
Let’s build a modern university from scratch
what does it take?

Edward F. Crawley,
President of Skolkovo Inst, of Science and Technology
Let’s build a modern university from scratch
what does it take?

- a Paradigm
  - practice makes perfect (CDIO, PBL, hands-on engineering, …)
- a Plan
  - Early introduction of modelling and simulation tools in engineering curricula
- the Right Tools
  - Available in quantity and in quality
## Industry «Voice of the customers»

### Engineering desired skills

<table>
<thead>
<tr>
<th>Disciplinary</th>
<th>Functional:</th>
<th>Personal:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Engineering and Math</td>
<td>• Design and build</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Operate and repair</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Thinking, planning</td>
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<td></td>
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<td>• Time management,</td>
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<td></td>
<td>• Ethics and integrity</td>
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<td>• Behaviour</td>
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<tr>
<td></td>
<td></td>
<td>• Teamwork, leadership</td>
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<td></td>
<td>• Communication</td>
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<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>• Customer</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Marketing</td>
</tr>
</tbody>
</table>

### Engineering education

<table>
<thead>
<tr>
<th>Disciplinary</th>
<th>Discipline specific:</th>
<th>Humanity electives</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Science and Math</td>
<td></td>
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<td></td>
<td>• Physics</td>
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<td></td>
<td>• Thermodynamics</td>
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<td>• Statics &amp; dynamics</td>
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<td>• Aero</td>
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<td>• EE</td>
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<td>• Civil</td>
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<td></td>
<td>• Chemical</td>
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<tr>
<td></td>
<td>• etc...</td>
<td></td>
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</tbody>
</table>

Along the way something got lost. We need to rethink engineering education and find a new balance.
Enabling the T-shaped engineer

Combining broad multi-disciplinary awareness…

…with deep subject knowledge.
To be successful engineers need a complex integration of practice skills and engineering math and science.
To be successful engineers need a complex integration of practice skills and engineering math and science.
Practical is what brings students closer to concepts, tools and problems that they will encounter in their professional life

Scott – Semiconductor

I figure out how to arrange transistors and wires to make them perform useful work. The majority of what I do all day, every day is communicate. Most days have at least an hour of meetings plus a good hour or two of email. The rest of my time is spent investigating problems found by HDL simulation.

Dan - Diesel Engine Manufacturing

I work as a research and test engineer for a major engine manufacturer. I am mostly doing work in the engine labs. When the data collection is finished, I am the one who analyzes the results and puts them in a nice form using programs like Excel and MATLAB

Johan: Software, Domotics Industry

My main responsibilities consist of designing and writing/implementing new functionality as the business or the customers require. This can include database design, System design or sometimes, no design at all.
Let’s build a modern university from scratch
what does it take?

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  - practice makes perfect

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- the Right Tools
  - Available in quantity and in quality
Michigan State University’s MATLAB integrated Curriculum for Chemical Engineering

Before

After

Year 1 | Year 2 | Year 3 | Year 4

Course using MATLAB / Simulink

Student’s computational problem-solving proficiency
“The efficiency that I have now when teaching fourth-year students is incredible. MATLAB is a common language we all speak. I don’t have to waste time bringing them up to speed, and as a result I can get much deeper into the subject material than in years past.”

Dr. Daina Briedis
Associate Professor
Chemical Engineering & Materials Science
“In years past, upper-level classes at Siena College were fragmented; some students were more comfortable with spreadsheets, others with a particular programming. This lack of uniformity was a challenge for professors.

This integration enables our students to develop practical skills...that they will use not only throughout their undergraduate studies at Siena...but for the next decade and beyond.”

Rose Finn, Michele McColgan, Graziano Vernizzi, and Allan Weatherwax
Siena College
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what does it take?

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MATLAB for Primary and Secondary Schools: PASS

Additional resources include:
- MATLAB and Simulink Tutorials
- Hardware for Project-Based Learning
- Courseware and Examples

**Suite Includes:** MATLAB, Simulink and 30+ add-on products
- Built in support for low-cost target hardware
- Installation across school, teacher, and student computers
MATLAB Home
Access the power of MATLAB for your hobbies

"MATLAB can help me implement algorithms and run models on Arduino, Raspberry Pi and LEGO NXT."

MATLAB® Home gives you the full capabilities of MATLAB for your personal use. It makes it easy to work on your ideas and have fun with personal projects such as modeling the stock market, enhancing your digital photos, or designing robots to show off your Arduino and Raspberry Pi skills.

Buy MATLAB Home
Starting at $150

For personal use only. Not for government, academic, research, commercial, or other organizational use.

Resources
- Additional MATLAB licenses are available for professionals, educators, and students.
- MATLAB Home FAQ

MATLAB EXPO 2014

Makers
the Right Tools, in quantity and quality
Total Academic Headcount licenses

MATLAB adoption
@ Worldwide Engineering Universities

• 22 of TOP 25 → 88%
• 37 of TOP 50 → 74%
the Right Tools, in quantity and quality

Total Academic Headcount licenses

Il Politecnico di Milano adotta MATLAB e Simulink per preparare i propri studenti alla professione nel settore dell’ingegneria.

Teaching Model-Based Design at Politecnico di Torino

By Massimo Violante, Politecnico di Torino

Torino, Ita

In the region around Turin, Italy, there is strong demand for engineers with the skills and knowledge required to develop complex, high-integrity embedded software. The need is particularly acute among automotive companies, but it affects avionics and other industries, as well. Companies seek engineers who can deliver sophisticated software in compliance with safety standards such as ISO 26262 and DO-178B while adhering to the MathWorks Total Academic Headcount Program (TAH).

Campus Matlab: programming environment for the development of algorithms, analysis and visualization of experimental data for the nur

The contract, through the TAH-Campus Option, allows all staff of the University to install the programme on all UNITN computers, both star and of UNITN.

The students of UNITN are also allowed, through the TAH-Student Option, to use Matlab everywhere, up to maximum four personal PC computers (CSITA). The programme Total Academic Headcount (TAH)
Wrap-up

- Make MATLAB part of the infrastructure

- MathWorks is keeping up with the trends in Formal, non-formal and informal education
  - Be ready to welcome students that are engineering pre-activated
  - Use the available brick and mortars to build the «ideal university»…

- MathWorks plays a big role in connecting Academia to industry