Cyber-Learning Activities in Taiwan --- EM Education

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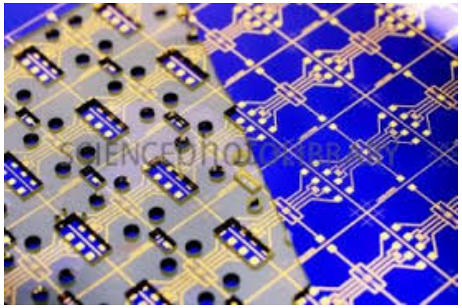
Agenda

- Motivation
- Mission
- Organization
- The Role of the Platform by NCHC
- Conclusion & Future Work
- Q&A

Motivations

Importance of EM field theory

- **From ELF to visible light**
- **From nano devices to ALMA.**
- **From communication to forecasting**



Motivations

Challenges in EM educations

- The very first course in EE that simultaneously requires
  - ➢ Mathematical skills with vector calculus
  - ➢ Physical understanding of wave propagation
- Long history, but we have a very limited time.
- Challenges from the emergent new fields in EE.
- Tendency of downplaying in the curricula in many universities.

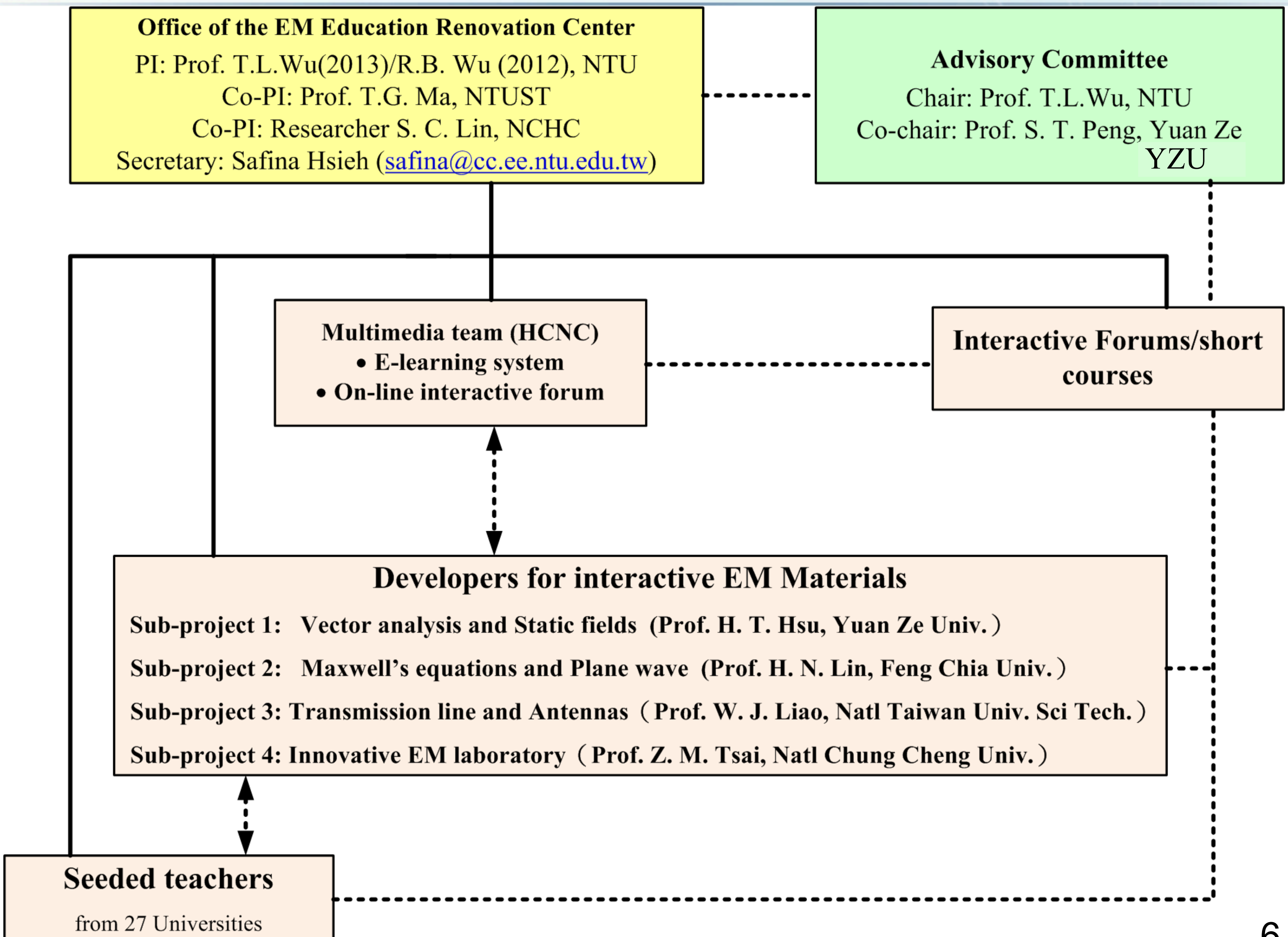
Mission

Project S A V E

- Simplicity
- Accessibility
- Visualization
- Edutainment

- Initiated and inspired by Prof. Peng and Prof. Wu in 2011.

Organization



Budget

- Two-year grant sponsored by the Ministry of Education, Taiwan.
- Courseware development: NTD 16,000,000.
- Promotion Program: NTD 27,000,000
  (27 universities in Taiwan to evaluate the developed materials through trial teaching.)
  - ✓ Provide feedback from the students
  - ✓ to evaluate and enhance the quiz bank.

The Platform base on the Main Principle

SIMPLICITY

ACCESSIBILITY

Cyber-Learning Platform for EM Education

VISUALIZATION

EDUTAINMENT

Simplicity

- Redraw the roadmap for fundamental EM education in Taiwan.
- Comply with the goal of simplifying and condensing the contents.
- Not to reproduce what in existent textbooks, but to develop innovative teaching thoughts and approaches.

Accessibility

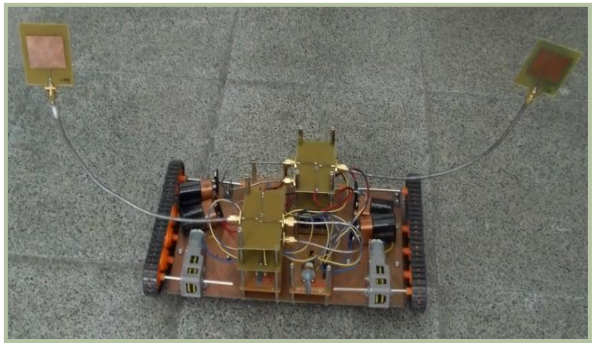
- Providing seamless accessibility regardless of the platforms.
- Taking advantage of modern mobile devices and high speed data links.
- Establishing tight connection with National Center for High-performance Computing (NCHC), Taiwan.

Visualization

- A number of EM Animations to elaborate the physical phenomena in EM fields/waves.
  - ✓ Have received excellent feedbacks.
- Video chips for self-learning
  - ✓ Semi-open course ware.
  - ✓ 15-20 mins per chip.
  - ✓ Customized self-learning paths.
  - ✓ Adaptive learning curve.

Edutainment

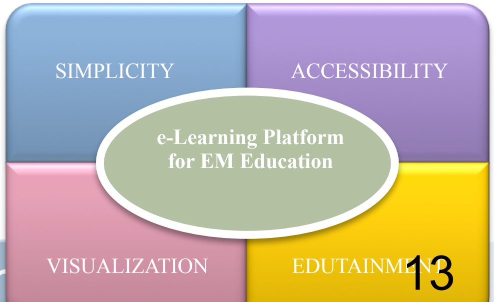
- Have fun with Creative "LEGO" Experiments.
  - ✓ to stimulate students' curiosity and interest toward EM theory.



- Have fun with EM Animations.
  - ✓ It does work!
- Have fun with the Video Chips and
  - ✓ "Enjoy" a quiz bank with more than 2200 problems collected from experts in Taiwan.

Cyber-Learning Platform for EM Education

- SAVE
  - S: provide **simplicity** and understandability multimedia course material
  - A: learning **accessibility** via internet
  - V: provide **visualization** EM math equation animation and simulation to help students understand EM math equations
  - E: learning through **edutainment** with multimedia course material, EM math equation animation and test bank



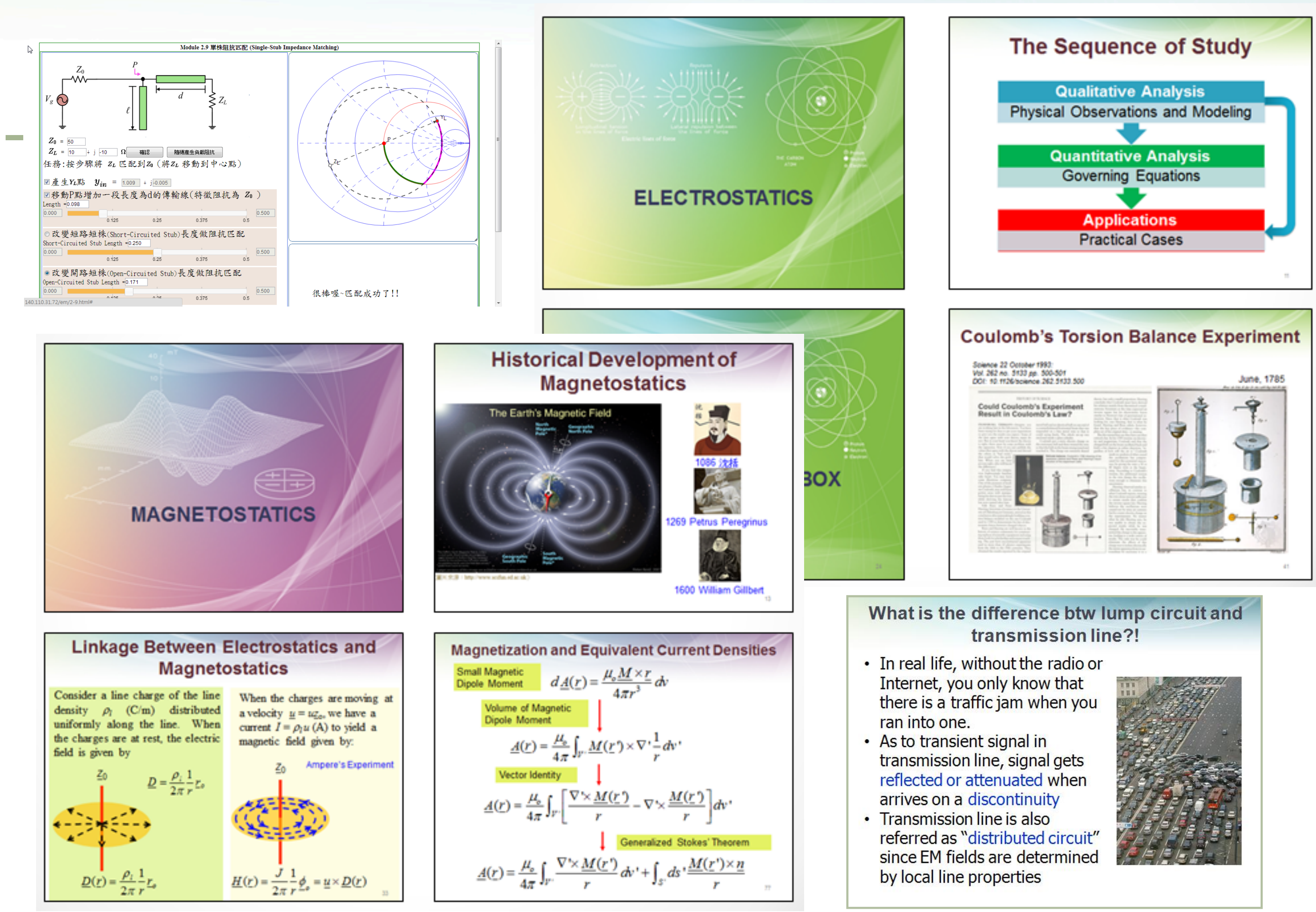
Simplicity

Accessibility

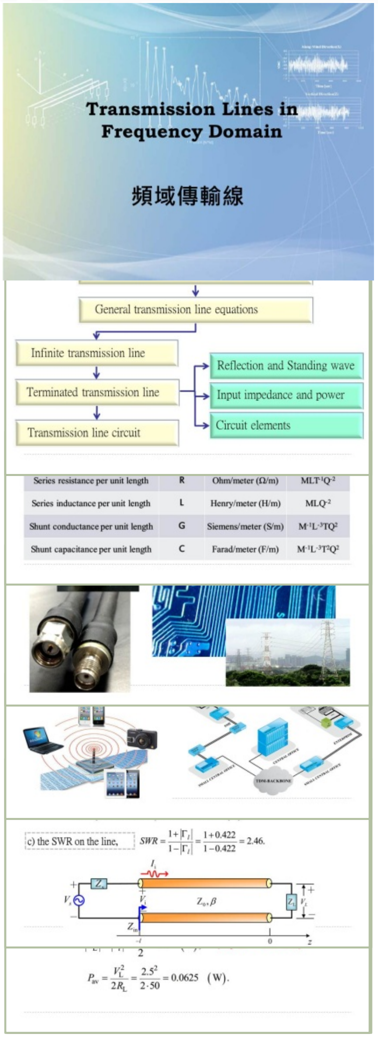
Visualization

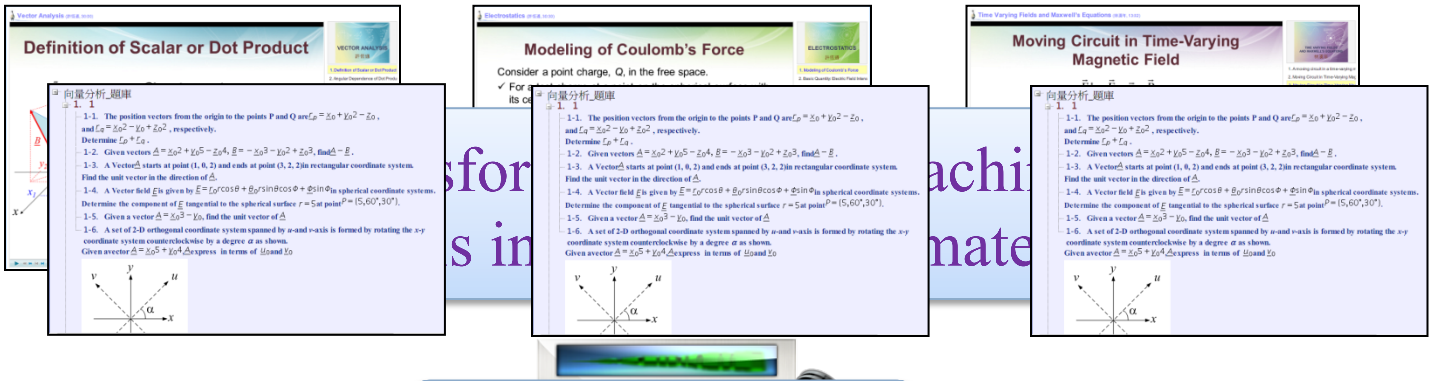
Edutainment

Some samples of the slides



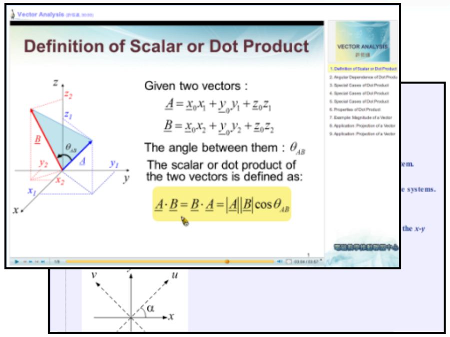
Teaching Material Simplicity

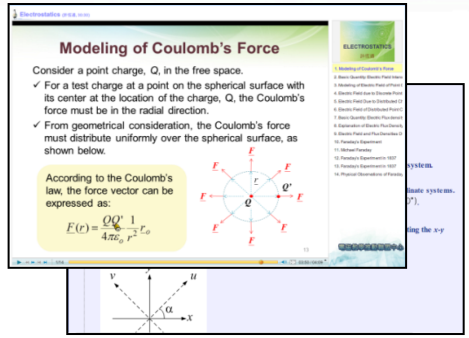


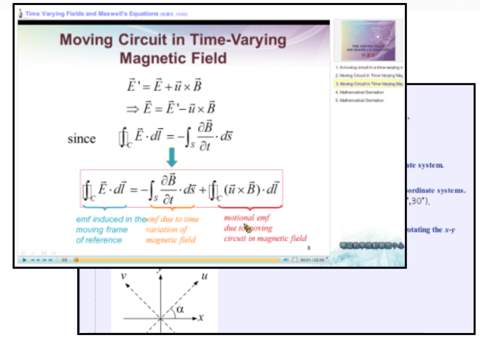


Divide the full teaching material (ppt) into several short teaching materials.

Content Management System







Contents and Interactive Animations

Test Bank

Content Management System

Simplicity

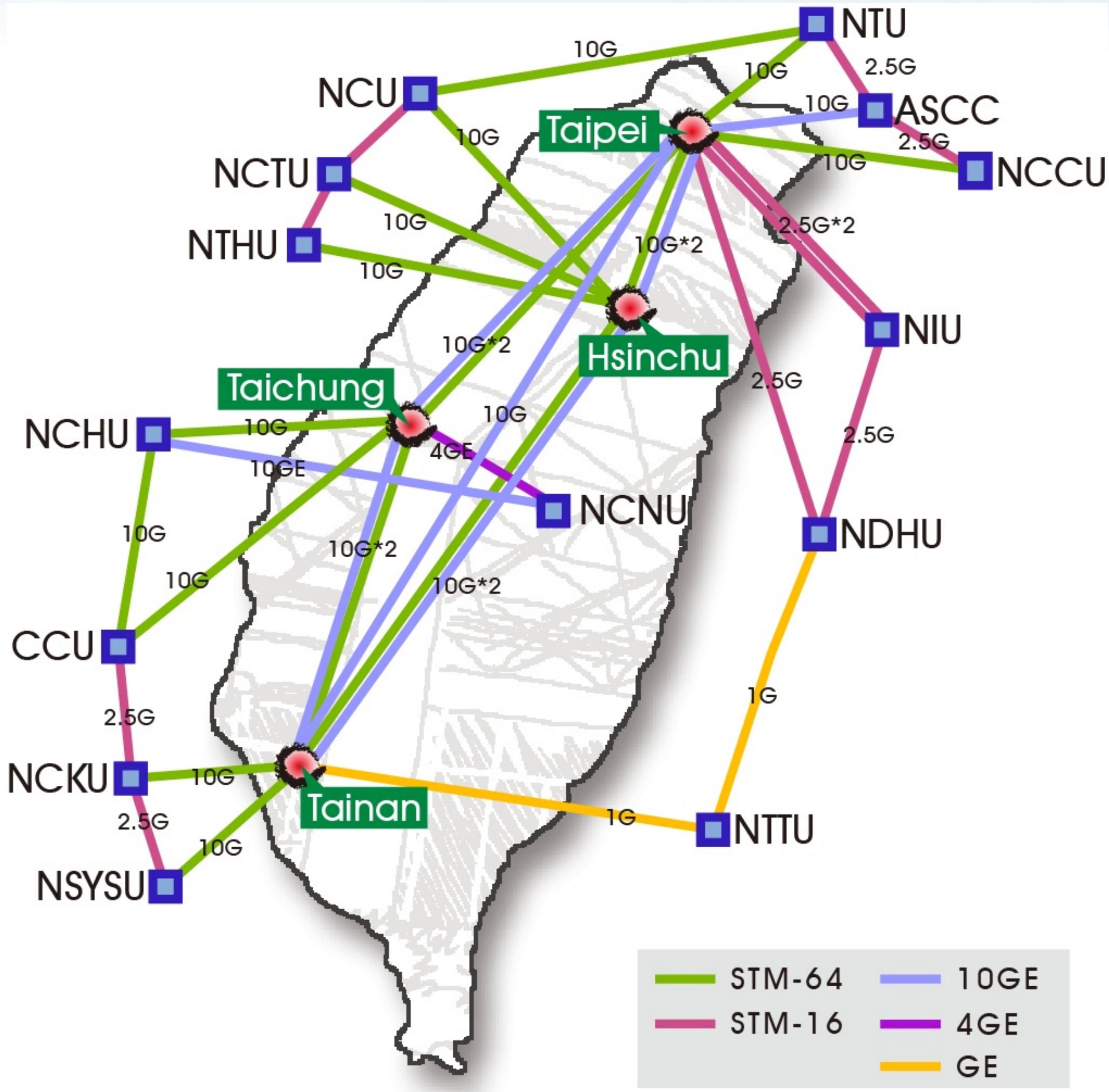
Accessibility

Visualization

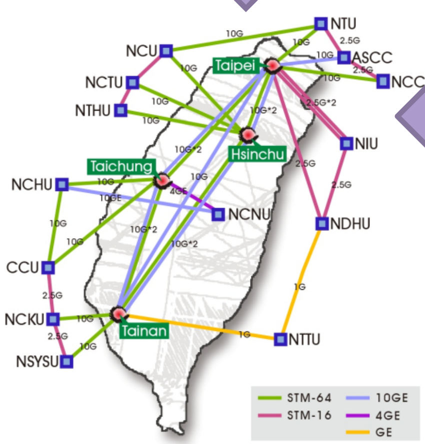
Edutainment

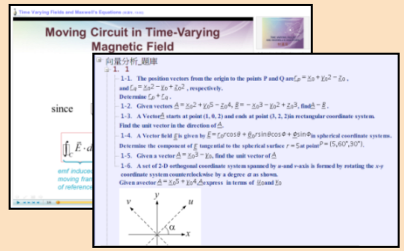
TWAREN Backbone Map

- four core nodes
  - The Taipei Node: Taipei Technology Building
  - The Hisnchu Node: Hsinchu Headquarter, NCHC
  - The Tainan Node: Southern Business Unit, NCHC
  - The Taichung Node: Central Business Unit, NCHC
- 12 regional network centers (a.k.a. GigaPOPs.)
- 1 access node

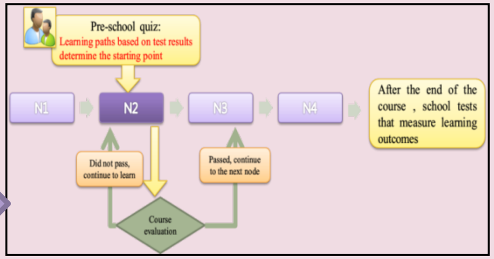


Cyber-Learning Platform for EM Education





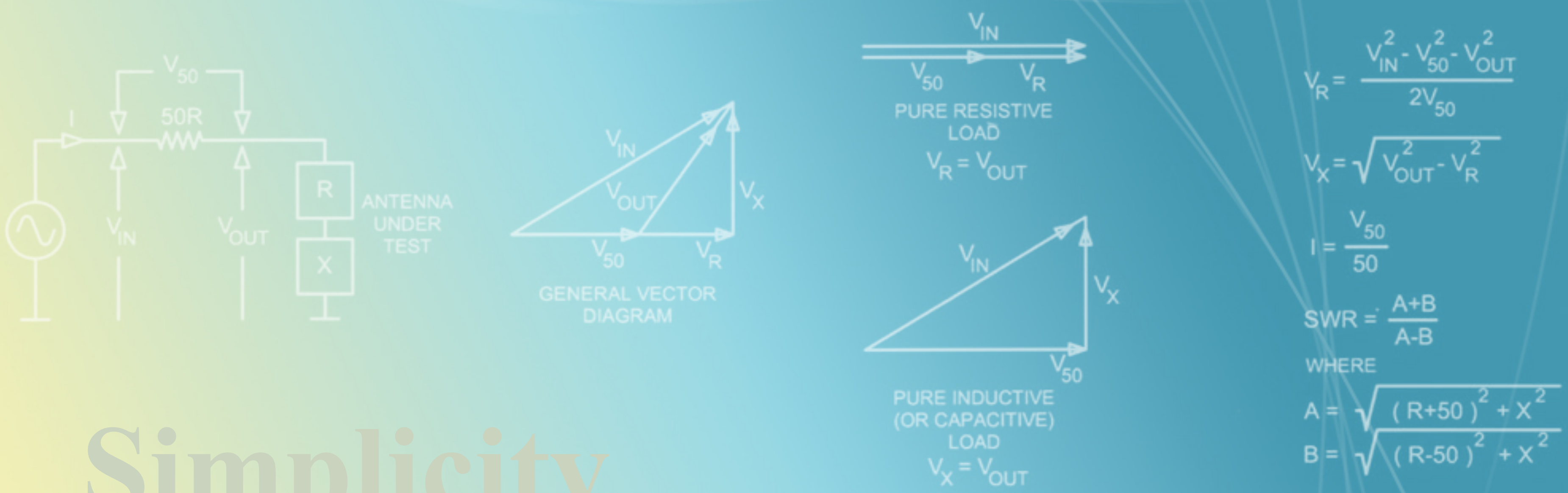
LCMS : manage teaching materials



LPMS : manage learning paths

LMS : manage class and students

Cyber-Learning Platform



Simplicity

Accessibility

Visualization

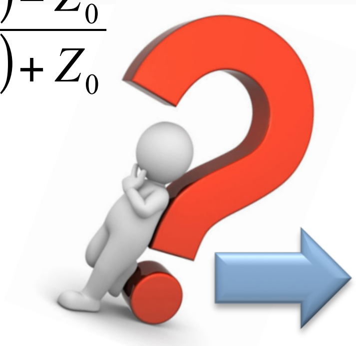
Edutainment

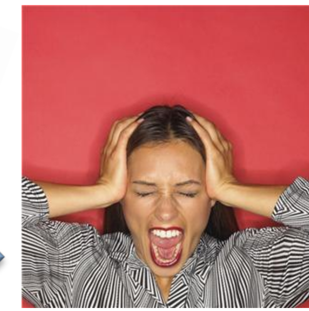
EM Math Equation Animation

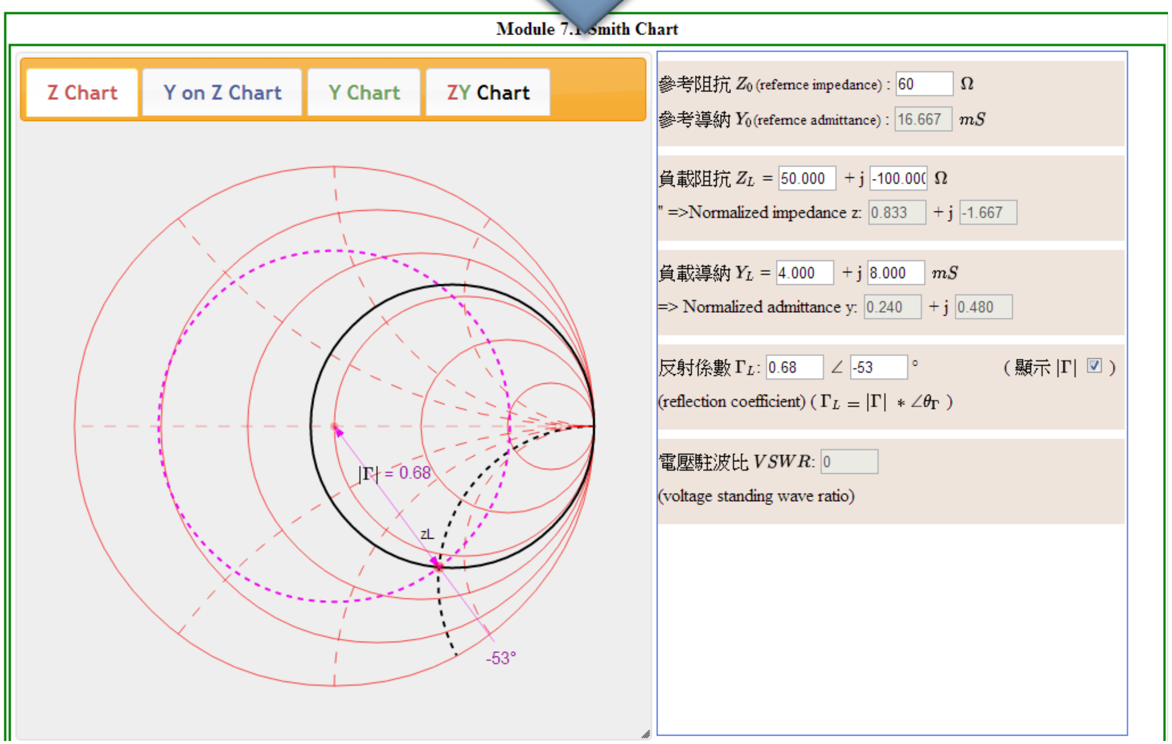
$$Z_{in}(z') = Z_0 \frac{Z_L + jZ_0 \tan(\beta z')}{Z_0 + jZ_L \tan(\beta z')}$$

$$\Gamma(z') = \Gamma_L e^{-2\gamma z'} = \frac{Z_{in}(z') - Z_0}{Z_{in}(z') + Z_0}$$

$$VSWR = \frac{1+|\Gamma|}{1-|\Gamma|}$$



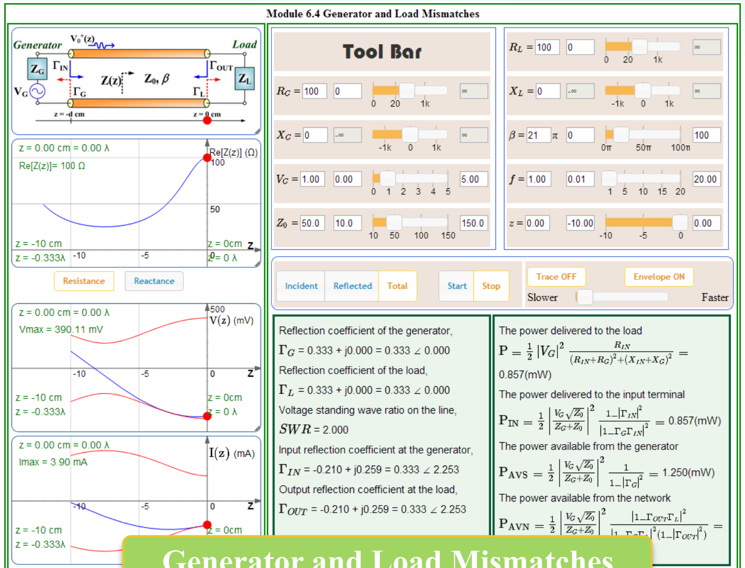




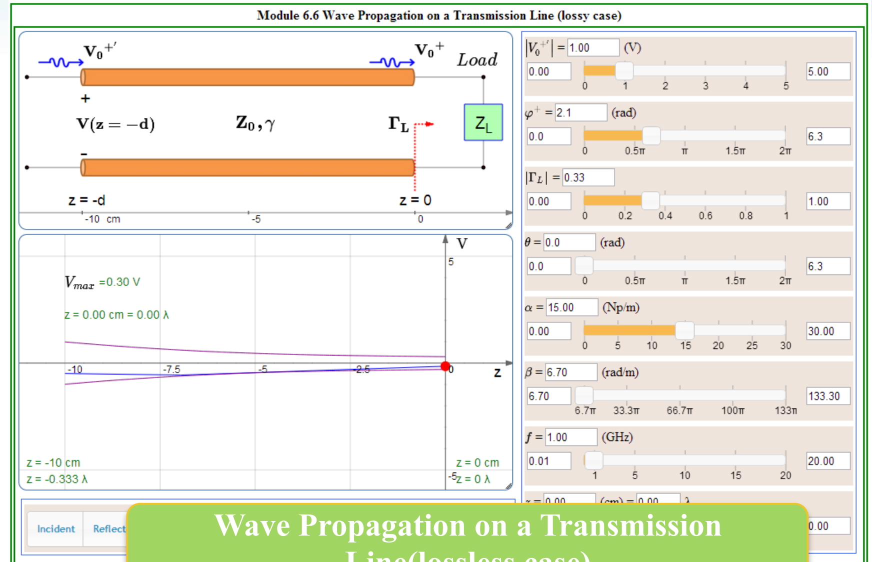
EM Math Equation Animation

- HTML5
- JavaScript
- CSS

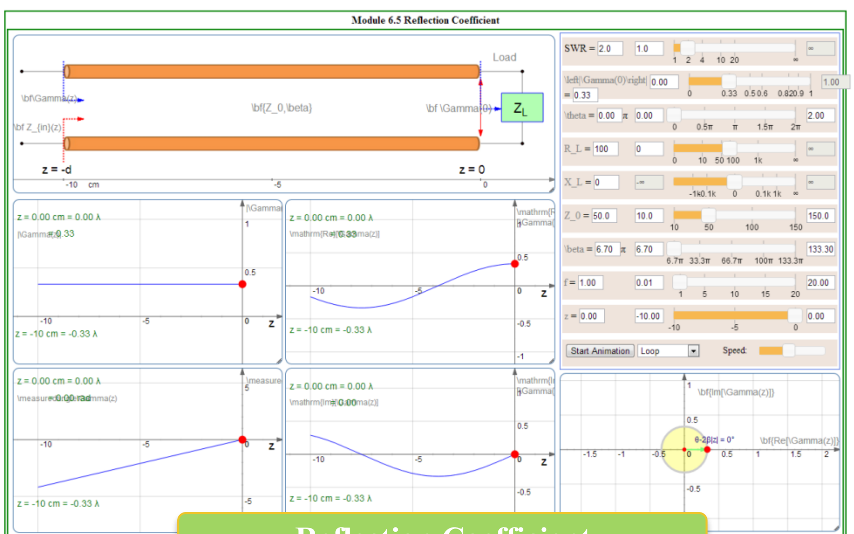
EM Math Equation Animation



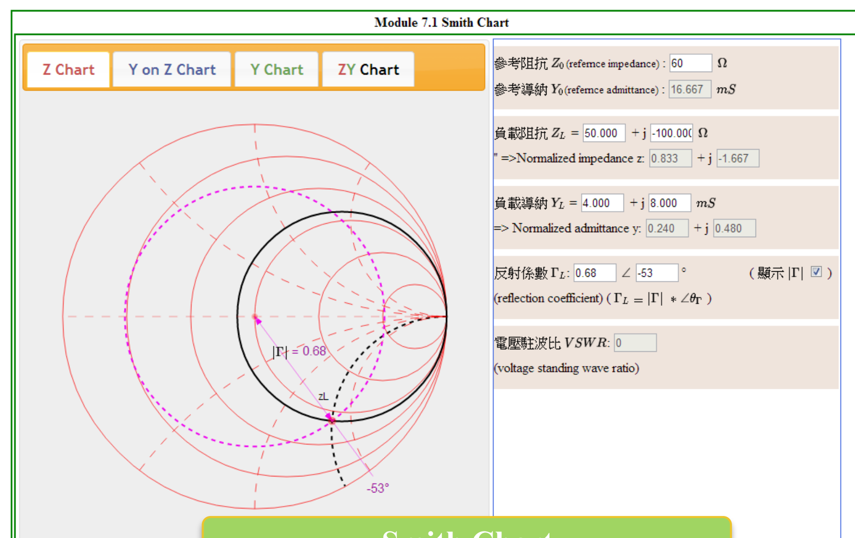
Generator and Load Mismatches



Wave Propagation on a Transmission Line(lossless case)



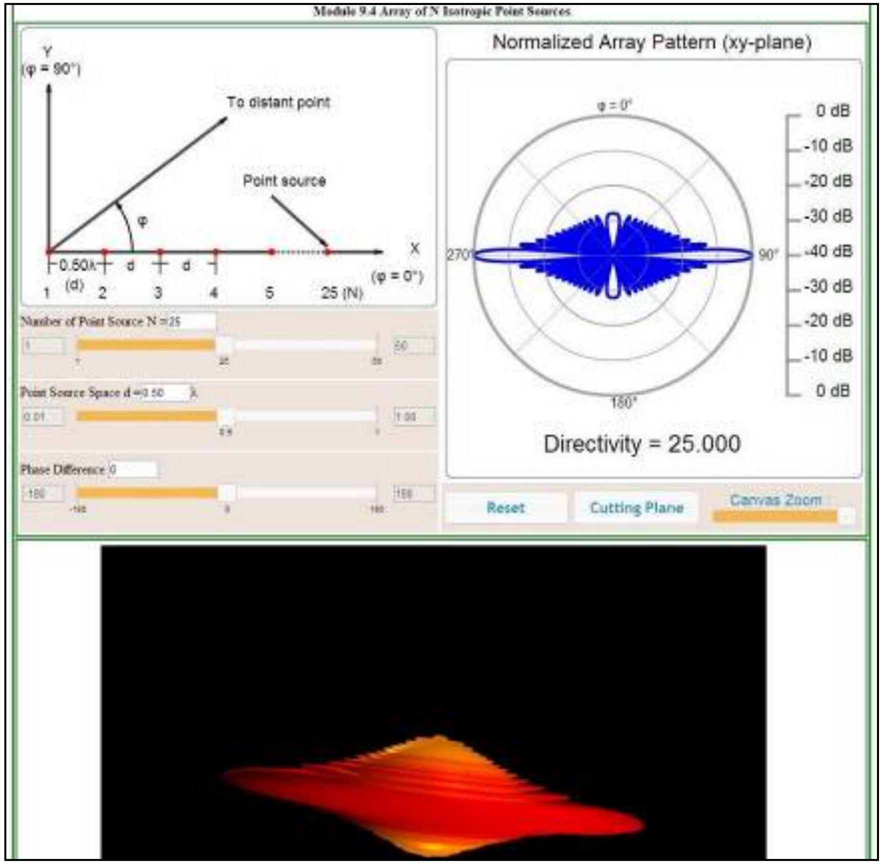
Reflection Coefficient

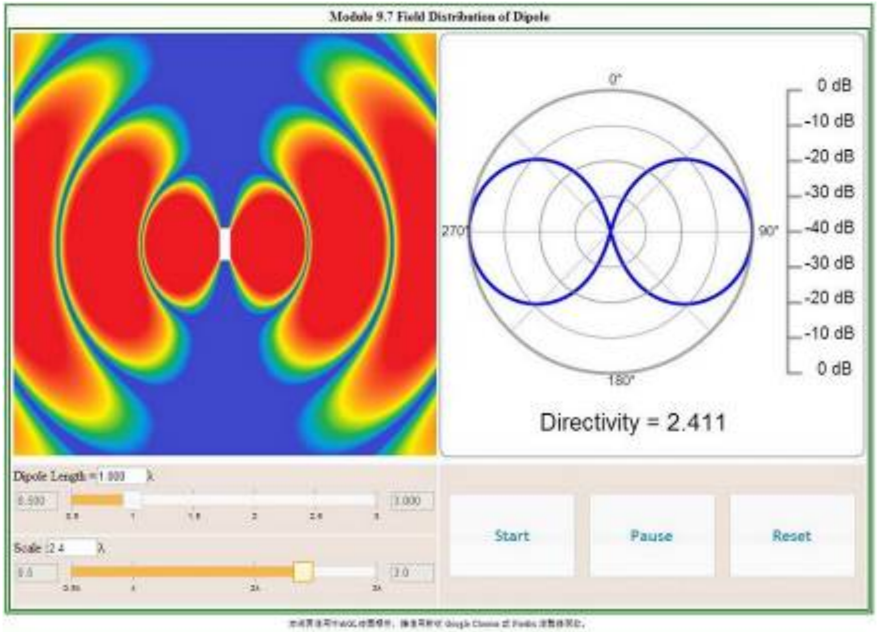


Smith Chart

EM Math Equation Animation

- New EM math equation animation will use WebGL to develop



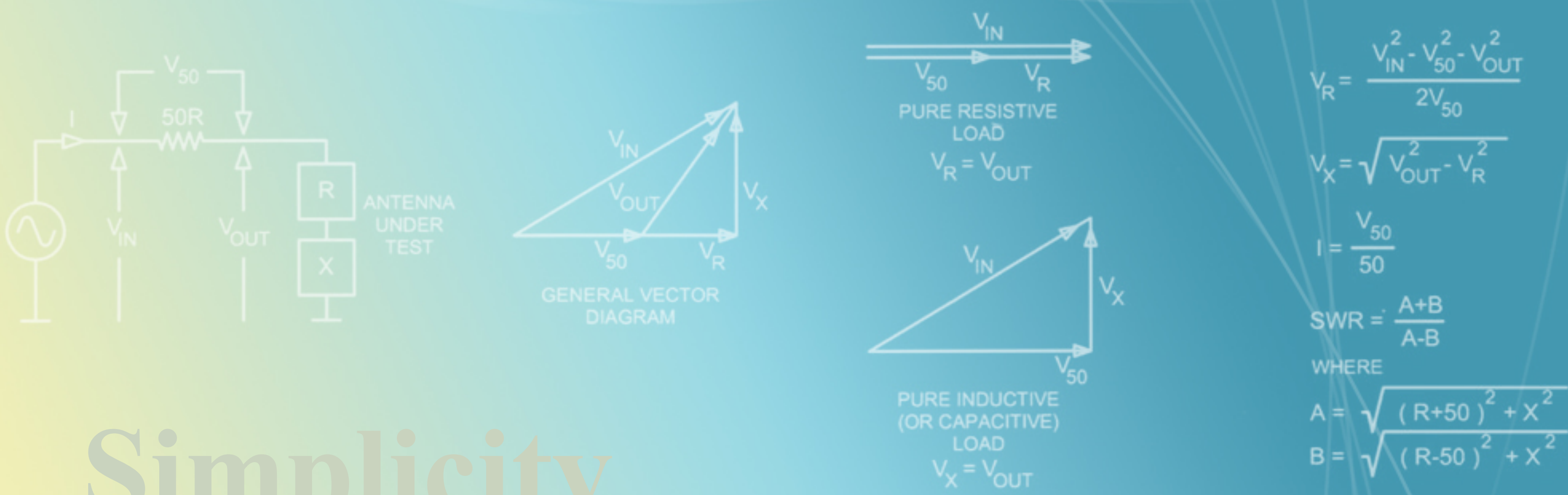


EM Math Equation Animation

- Ch5. Time Domain Transmission Line
  - 5.1 Bouncing Signal in T. Line w/ DC Source
  - 5.2 Bouncing Signal in T. Line w/ Impulse Source
  - 5.3 Bouncing Signals in 3 Sec. T.-Line w/ Pulse Source
  - 5.4 Bouncing Signal in a T.-Line System w Shunt/Series Discontinuity
- Ch6. Transmission Lines
  - 6.1 Wave Propagation on a Transmission Line(lossless case)
  - 6.2 Standing Wave Pattern(lossless case)
  - 6.3 Input Impedance
  - 6.4 Generator and Load Mismatches
  - 6.5 Reflection Coefficient
  - 6.6 Wave Propagation on a Transmission Line (lossy case)
  - 6.7 Standing Wave Pattern (lossy case)

EM Math Equation Animation

- Ch7. Smith Chart
  - 7.1 Smith Chart
  - 7.2 Smith Chart and Transmission Lines
  - 7.3 Quarter-wavelength Transformer
  - 7.4 Single-Stub Impedance Matching
  - 7.5 Double-Stub Impedance Matching (八分之一波長)
  - 7.6 Double-Stub Impedance Matching (十六分之一波長)
- Ch9. Antennas
  - 9.1 Linear Polarization
  - 9.2 Circular Polarization
  - 9.3 Elliptical Polarization



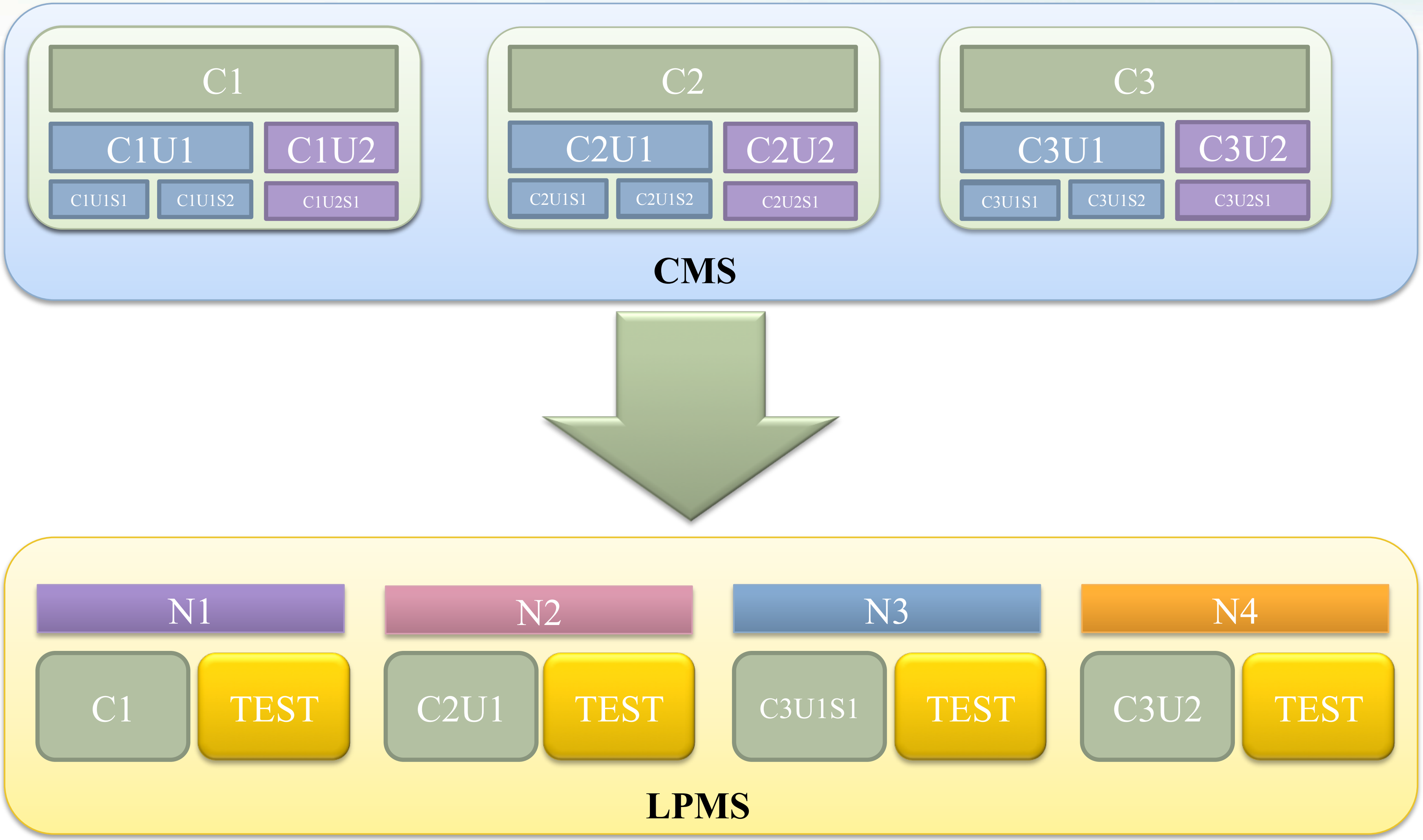
Simplicity

Accessibility

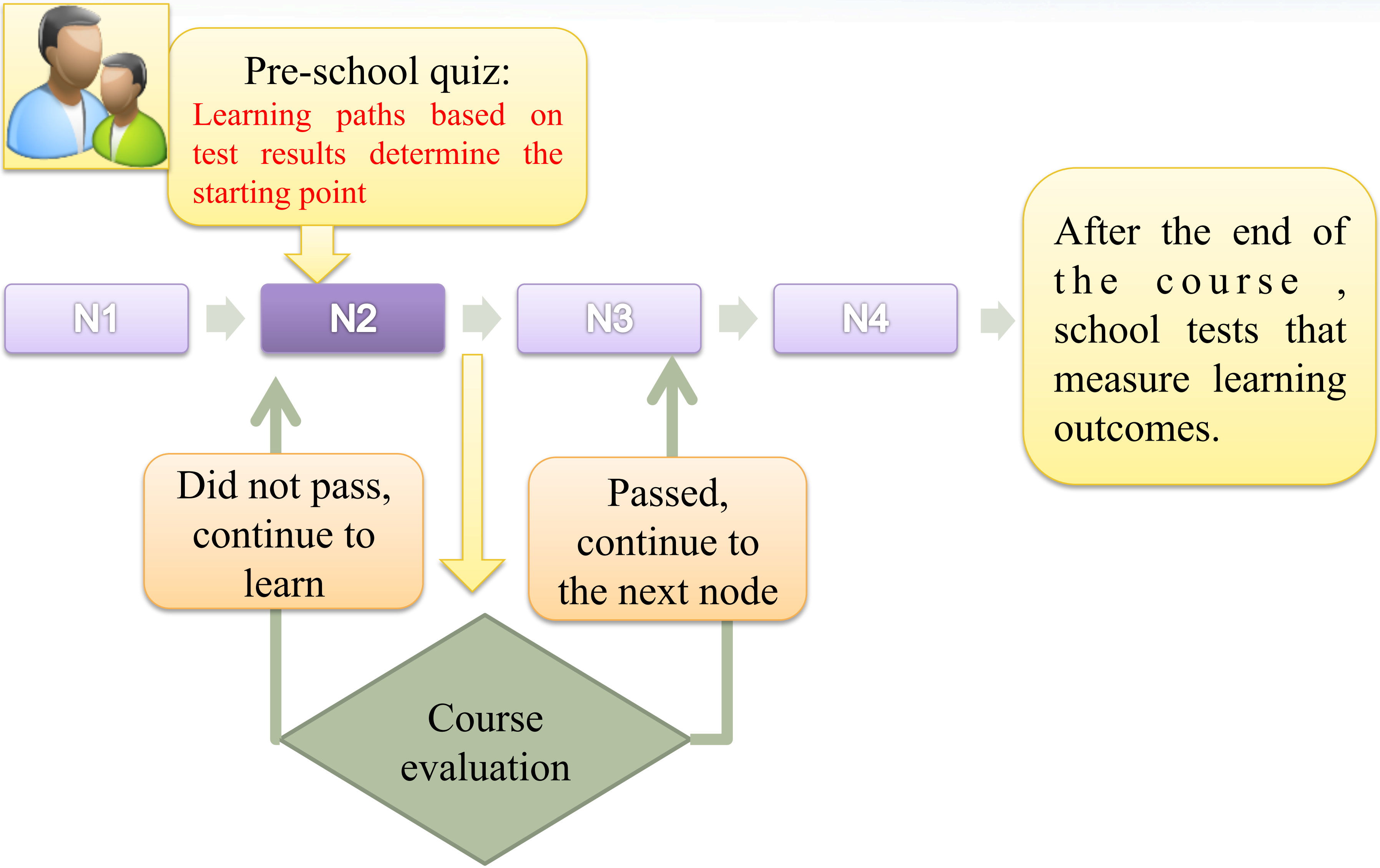
Visualization

Edutainment

Dynamic Learning Path Management



Dynamic Learning Path



CONCLUSION & FUTURE WORK

Conclusion

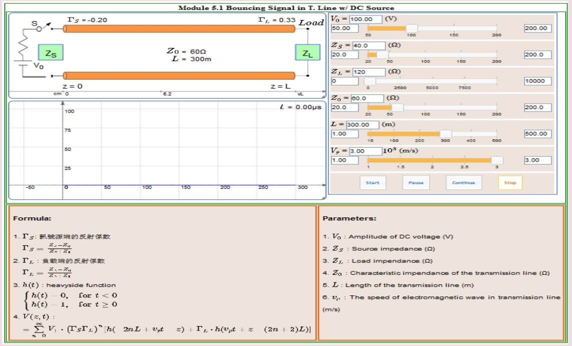
- Cyber-learning Platform
  - LCMS, LMPS, LMS, …
- Content
  - Test Bank (3,835 tests)
  - Learning Path (207 paths)
  - 9 courses (60 hours)
  - 29 math equation animations
- Activity
  - 28 university/college, 125 classes, 169 teachers, 3,894 students, 230 lectures

Future Work

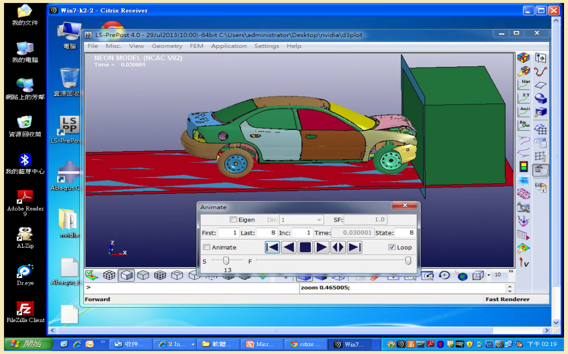
- Increase the Content
  - Test bank
  - Animation
  - Course set
- Provide the learning platform on mobile devices(android, iOS)
- Create the Simulation-base Learning System

Future Work

Multimedia-base learning (GUI run on local)

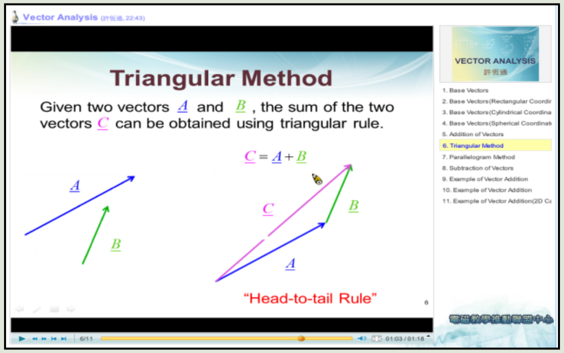


Simulation-base learning (GUI run on remote)



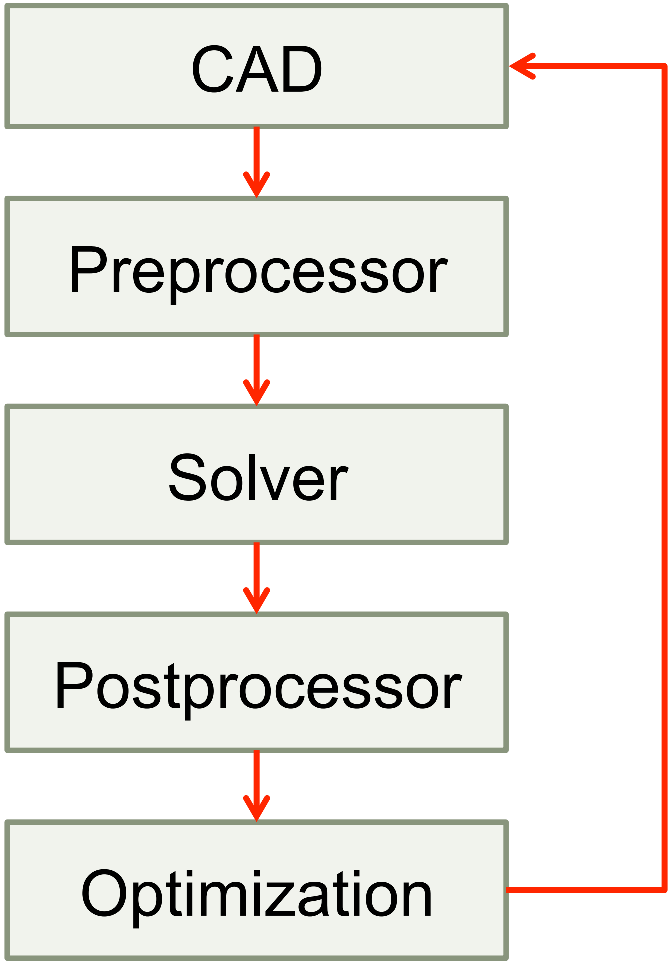
Digital material

Powerpoint， video/audio



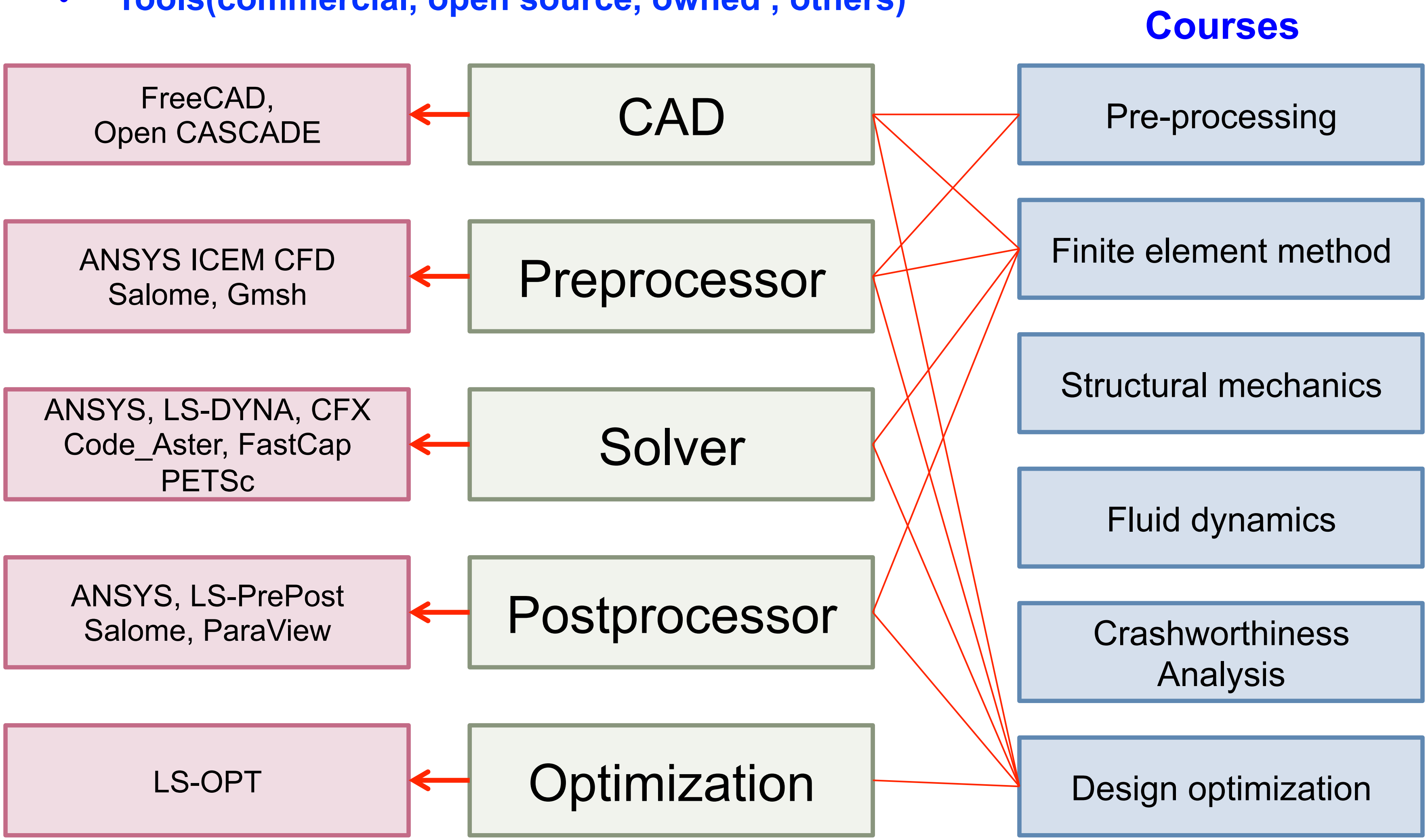
Future Work

- **Numerical simulation**



Future Work

- **Tools(commercial, open source, owned , others)**



Q & A

TEACHING MATERIAL QUANTITIES DEVELOPED IN COURSE MODULES OF THREE WORKGROUPS.

	Course Modules	Developed Teaching Materials	
		Module Details	Workgroup Summary
Workgroup #1	Vector Analysis	206 slides, 202 problems, 10 hrs video clips, 2 interactive labs	587 slides, 632 problems, 26 hrs video clips, 4 interactive labs
	Static Electrics	213 slides, 212 problems, 8 hrs video clips, 1 interactive labs	
	Static Magnetics	168 slides, 216 problems, 8 hrs video clips, 1 interactive labs	
Workgroup #2	Maxwell Equations	81 slides, 171 problems, 11 hrs video clips, 1 interactive labs	394 slides, 446 problems, 22.5 hrs video clips, 5 interactive labs
	Waveguides	175 slides, 64 problems, 2.5 hrs video clips, 2 interactive labs	
	Uniform Plane Wave	138 slides, 211 problems, 12 hrs video clips, 2 interactive labs	
Workgroup #3	Transmission Line in Freq. Domain	82 slides, 285 problems, 7.5 hrs video clips, 7 interactive labs	353 slides, 840 problems, 18.5 hrs video clips, 28 interactive labs
	Smith Chart	61 slides, 191 problems, 6 hrs video clips, 7 interactive labs	
	Transmission Line in Time Domain	102 slides, 210 problems, 5 hrs video clips, 7 interactive labs	
	Antenna	110 slides, 154 problems, 7 interactive labs	
WG #4	EM Laboratories	360 slides, 160 pages lab manual, 39 problems, 4 sample lab designs	