Women Engineers in Electromagnetics and Related Technology

Special Lecture WIE Japan Council

28 July 2007, Tokyo

Contents

My point of view about women engineers

First, My point of view

- **Attitude for women in choosing engineering profession**
  - Men and women have equal right to choose their suitably professions.
  - Men and women should share their responsibility to develop better world for the future.
  - Women should have profession in order to secure and support family.
  - In the 21th century, both men and women should working together to solve many serious problems of the world such as global warming.

EE is an appropriate profession for women

1. **Women can use their talents in mathematics and science to solve engineering problem by using brain power.**
2. **Electrical engineering design requires neatly and systematically skills which can be accomplished by women.**
3. **As the scale of devices in EE becomes smaller and smaller, women can doing experiments without using so much muscle power.**
4. **As computers become more powerful day by day, women can develop or use software for simulation and computer-aid design.**

EE is an appropriate profession for women

5. **The EE work loads can be managed, so women can share their time between family and profession.**
6. **There are variety of fields in electrical engineering for women to choose.**
7. **Women can choose fields in electrical engineering appropriately to their talents.**
8. **Electrical engineering is one of major field in engineering which can be applied to develop better world.**

About myself (1)

- **Name:** Tuptim Angkaew
- **Place of birth** Bangkok, Thailand
- **Generation** Baby boom (1960’)
- **Family** Father: Medical Doctor (Medical school Professor)
  Mother: Food nutritionist (Working as housewife)

About myself

- **Bachelor** — 1984 B.E. from Faculty of Engineering, King Mongkut 's Institute of Technology, Ladkrabang
- **Graduate** — 1987 M.E. in Communication Engineering, Osaka University, Japan
  1990 D.E. in Communication Engineering, Osaka University, Japan

Women in Thai society?

Women in Thai Society 200 years ago

Thai proverb

Role of men is similar to an elephant's front legs.

Role of women is similar to an elephant's rear legs.

Women in Thai Society 100 years ago

- **In the past 100 years ago, Thai women had started go to school and can choose their own profession in limited fields.**
- **It became popular for Thai women to obtain higher level of education.**
- **Some Thai women was educated in Europe and US.**
- **Chulalongkorn university is the first university in Thailand established 90 years ago. There were Thai women enrolling in higher education at CU at the beginning period.**

Women in Thai Society 25 years ago

- **It became popular for Thai women to study in science and engineering.**
- **The number of women in all area of science and technology have been growing year by year.**
- **In electrical engineering profession, the percentage of women engineers is around 20% - 30%.**
- **Thai women can earned more money to secure their family.**
- **Many Thai women can hold leadership positions.**

Why I have chosen electromagnetic as a profession

Why I have chosen electromagnetic as a profession? (1)

- It started 22 years ago in 1985.
- After graduating with BE, I had a plan to study in Master course.
- I intended to study in optical fiber communication which was popular at that time.
- I applied Monbusho scholarship.
- I was granted scholarship to study at Osaka university under supervision of Prof. Nobuaki Kumagai.
- Prof. Masanori Matsuhara was my supervisor. He worked on Computational Electromagnetics.

How I get involve in electromagnetics

I had intention to study about optical fibers.

I was granted Monbusho scholarship .

Prof. Nobuaki Kumagai accepted me to study in lab.

I and the Maxwell's equations

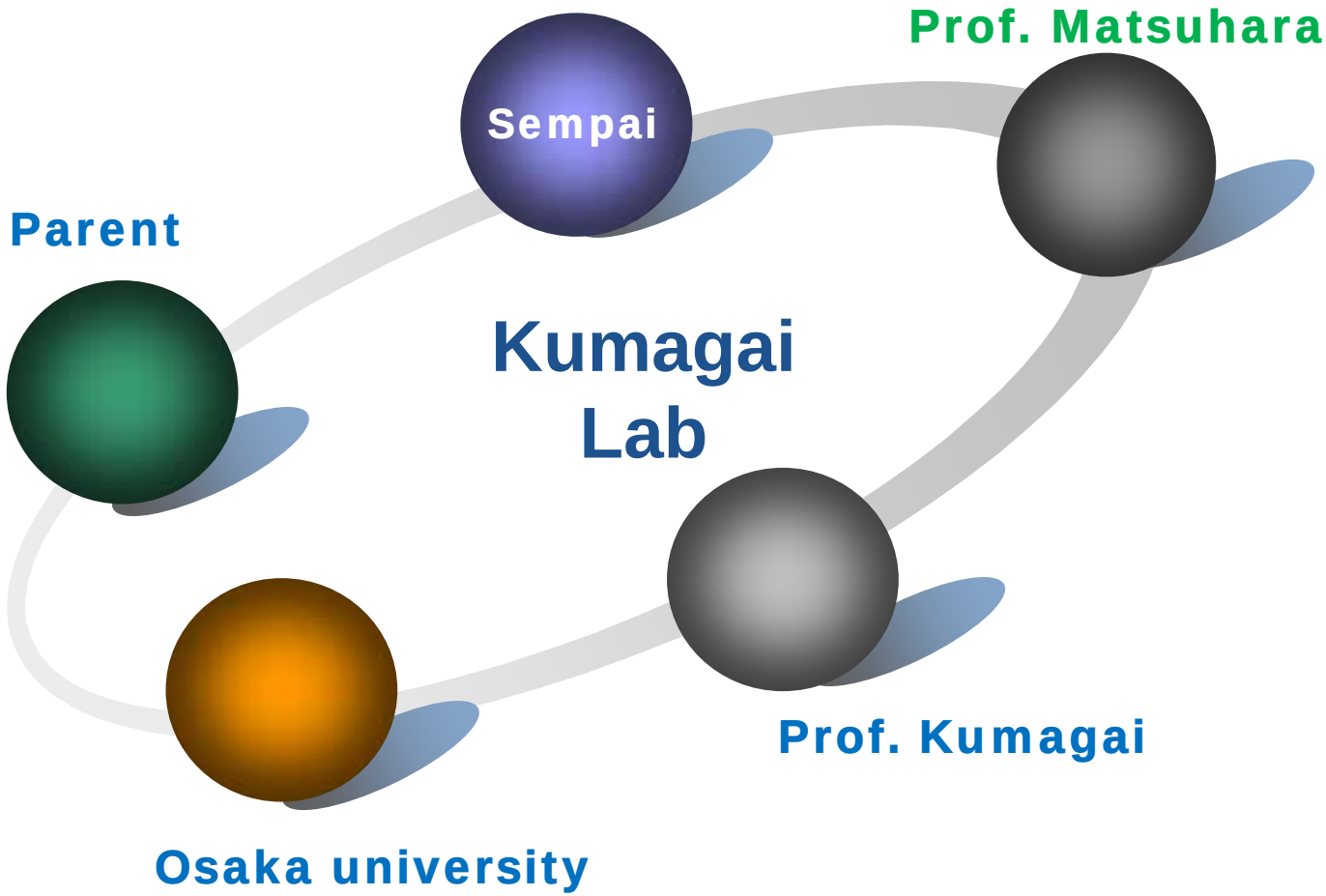
$$\nabla \times \vec{E} = -\frac{\partial \vec{B}}{\partial t} \qquad \text{Faraday's Law}$$

$$\nabla \times \vec{H} = \vec{J} + \frac{\partial \vec{D}}{\partial t} \qquad \text{Ampere - Maxwell's Law}$$

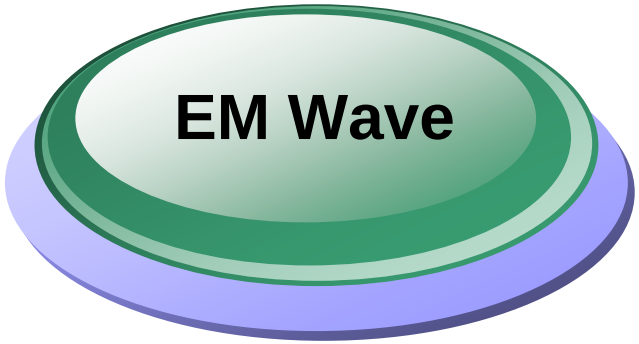
$$\nabla \cdot \vec{B} = 0 \qquad \text{Gauss's Law in Magnetic Field}$$

$$\nabla \cdot \vec{D} = \rho_v \qquad \text{Gauss's Law in Electric Field}$$

Supporting Environment at the beginning



Research fields in Kumagai Lab.



Microwave & Millimeter wave

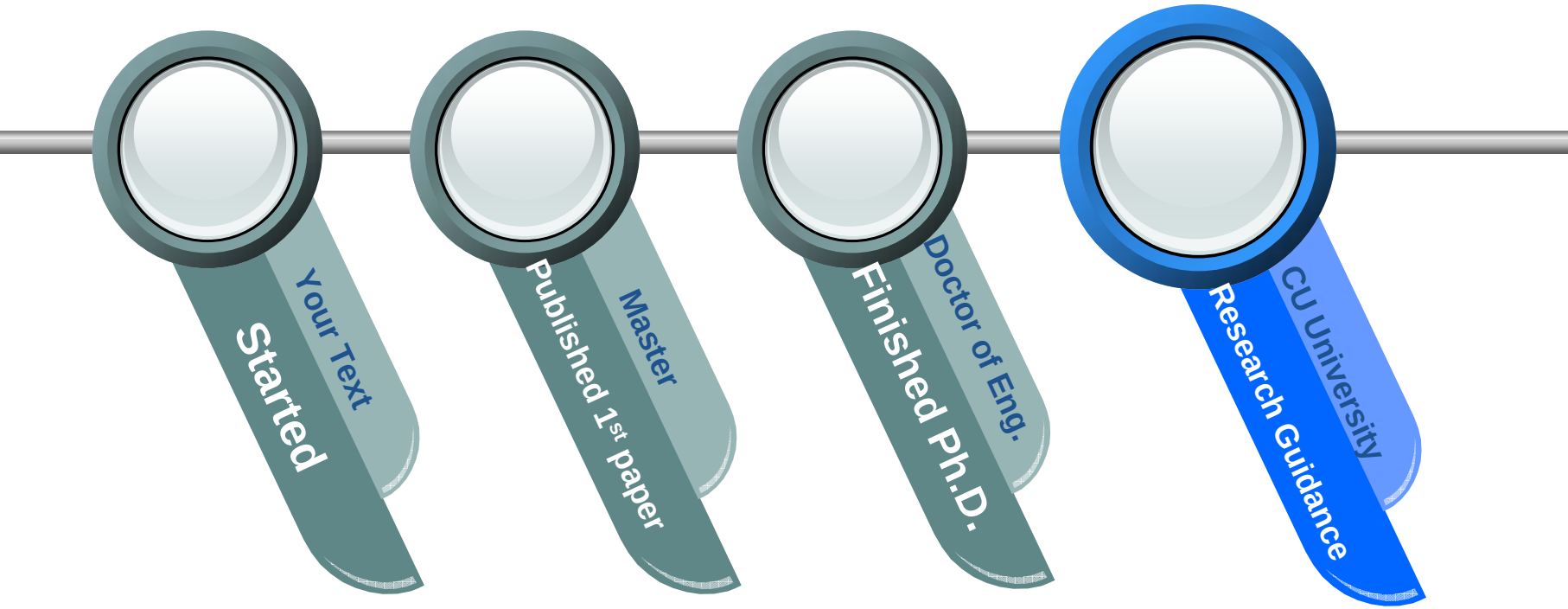
- **Experiments**
- **Analytical methods**

Optical wave & Microwave

- **Computational method**
  - **FEM**
  - **BEM**

Time line of my experience on EM

1985 → 1987 → 1990 → **2007**



My research unit on electromagnetic wave at CU

Join EE Dept.

In 1990
I have jointed EE Department, Chulalongkorn University as a lecturer on electromagnetics subjects.

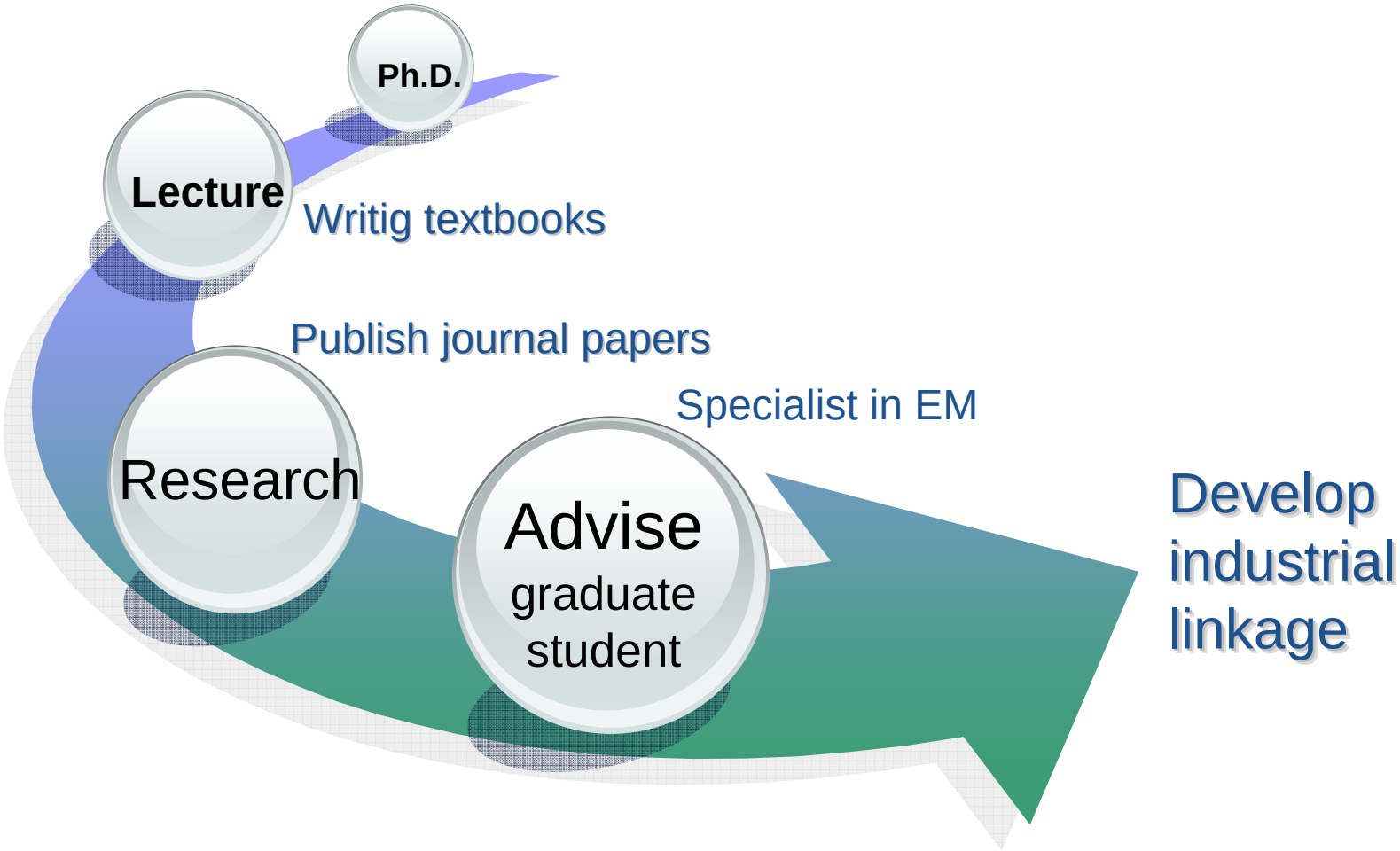
EMW Lab.

In 1993
EE Department has established Research Laboratory in Electromagnetic waves.
I was appointed as Head of EMW lab.

Future

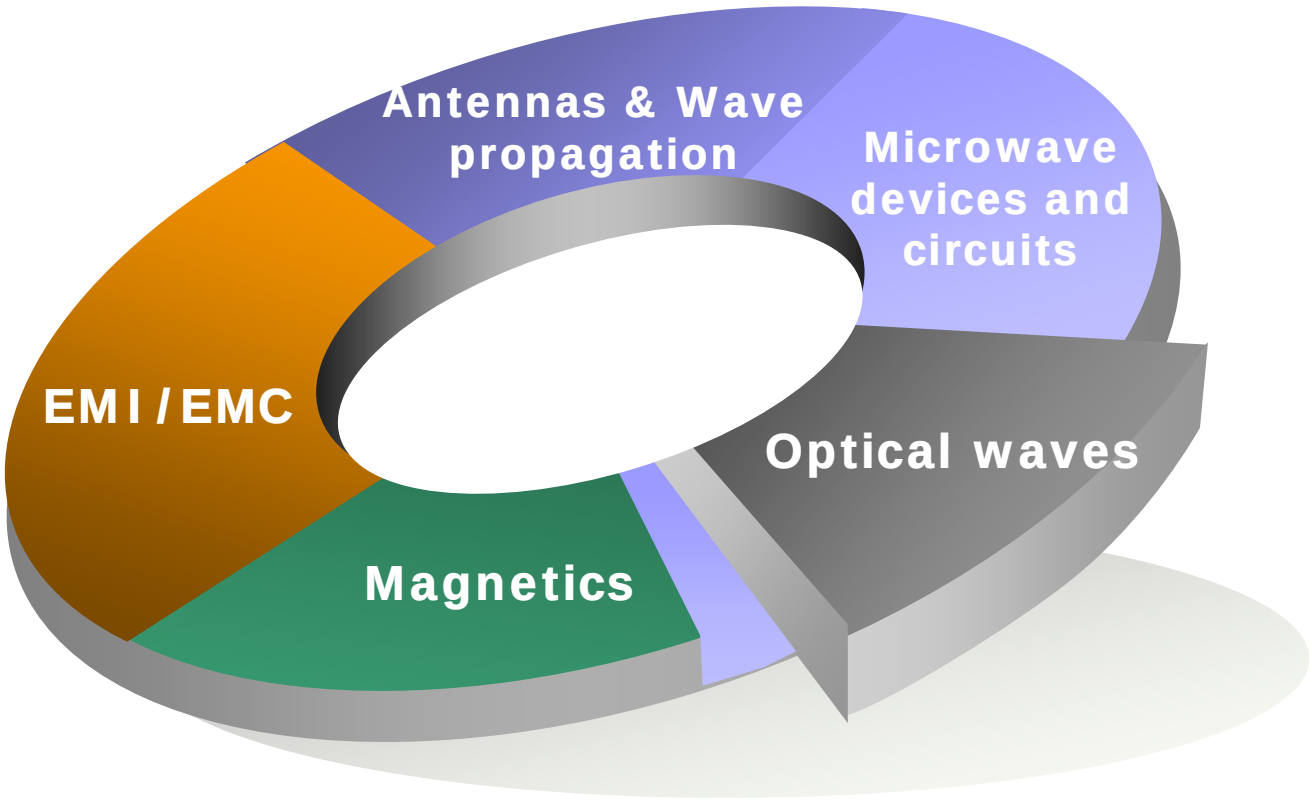
EMW Lab. may be clustered into Center of Excellence in Communication.

My aim at work

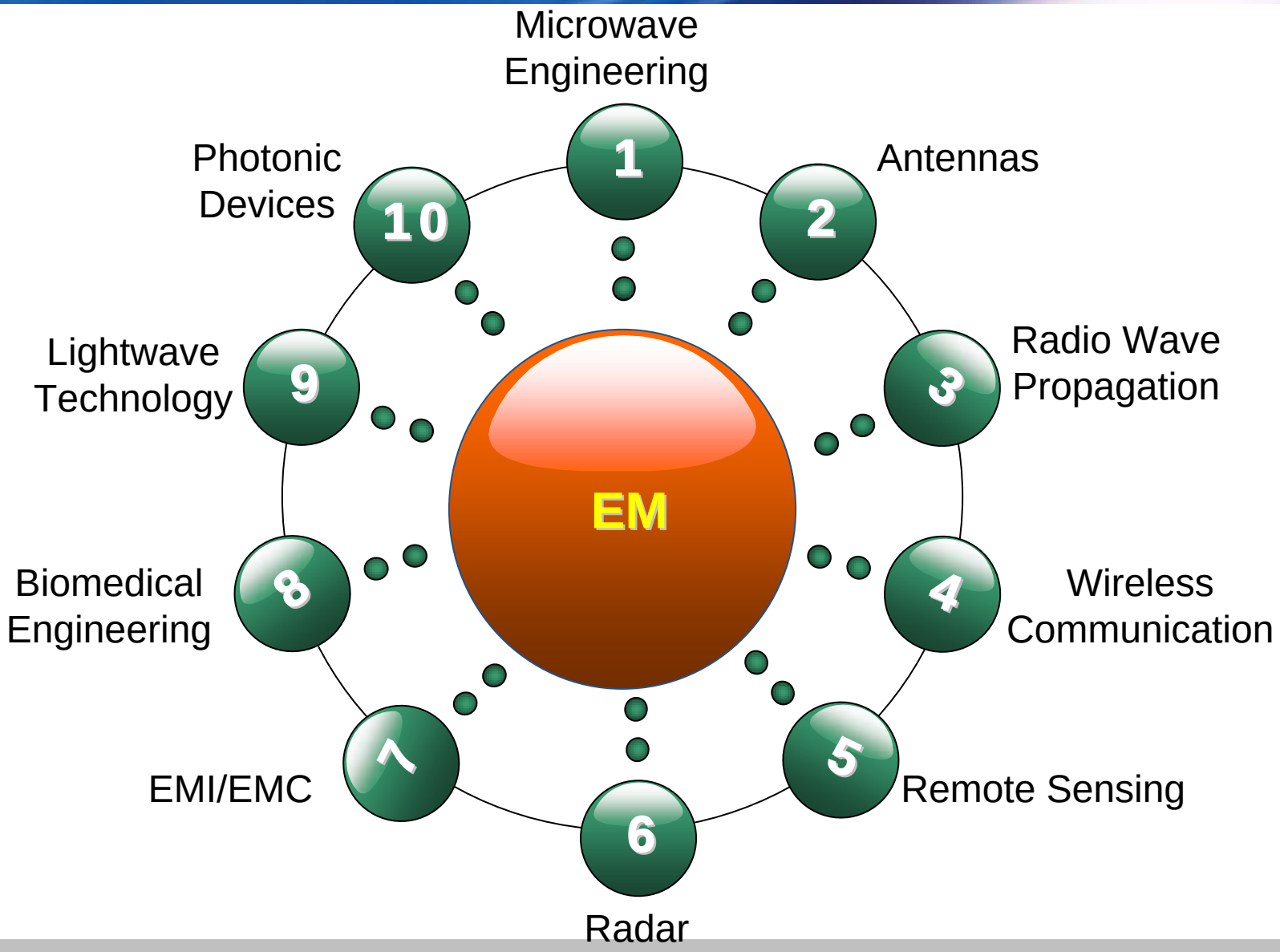


Electromagnetics and Related Engineering Fields

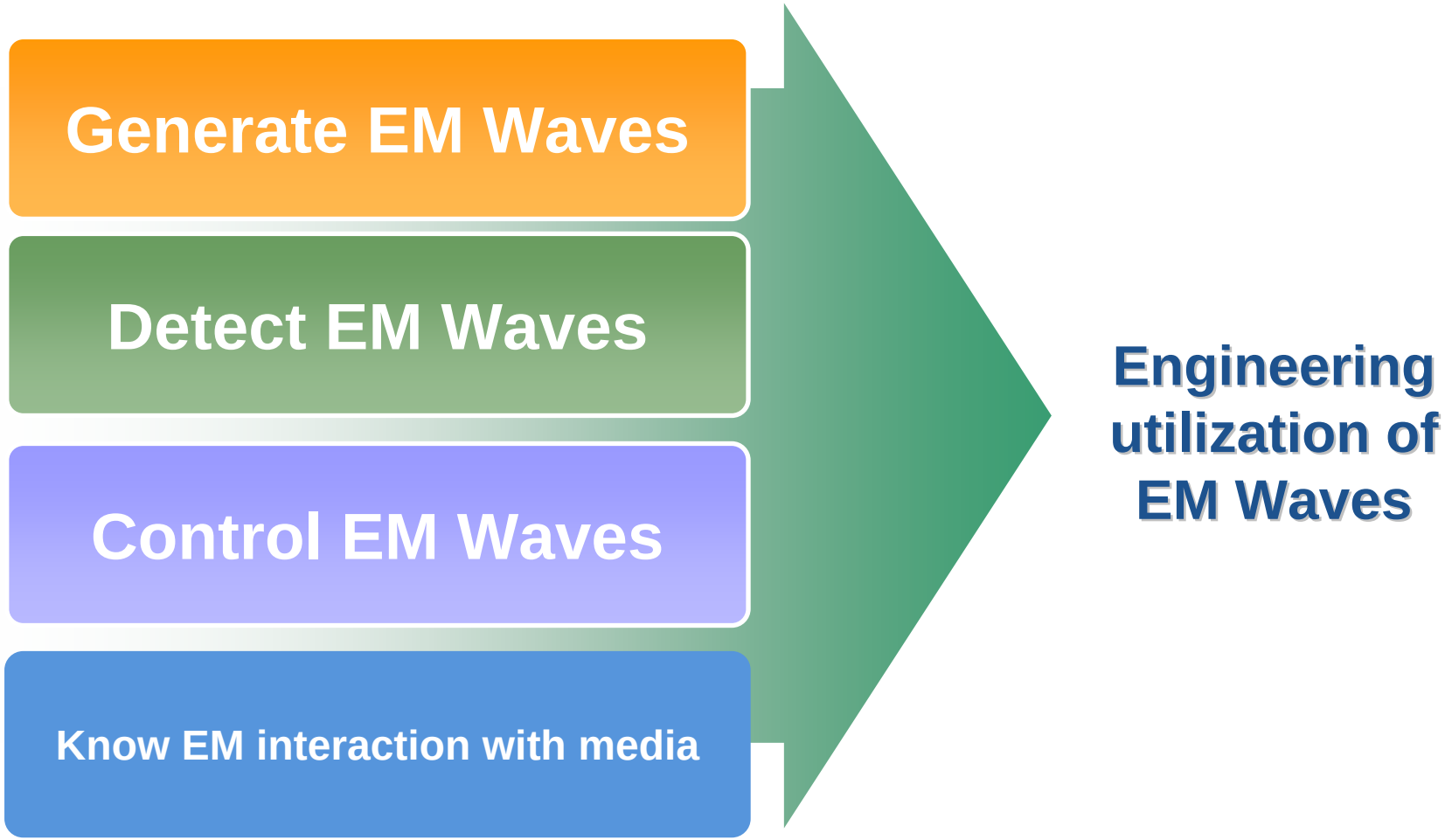
Major engineering fields related to EM



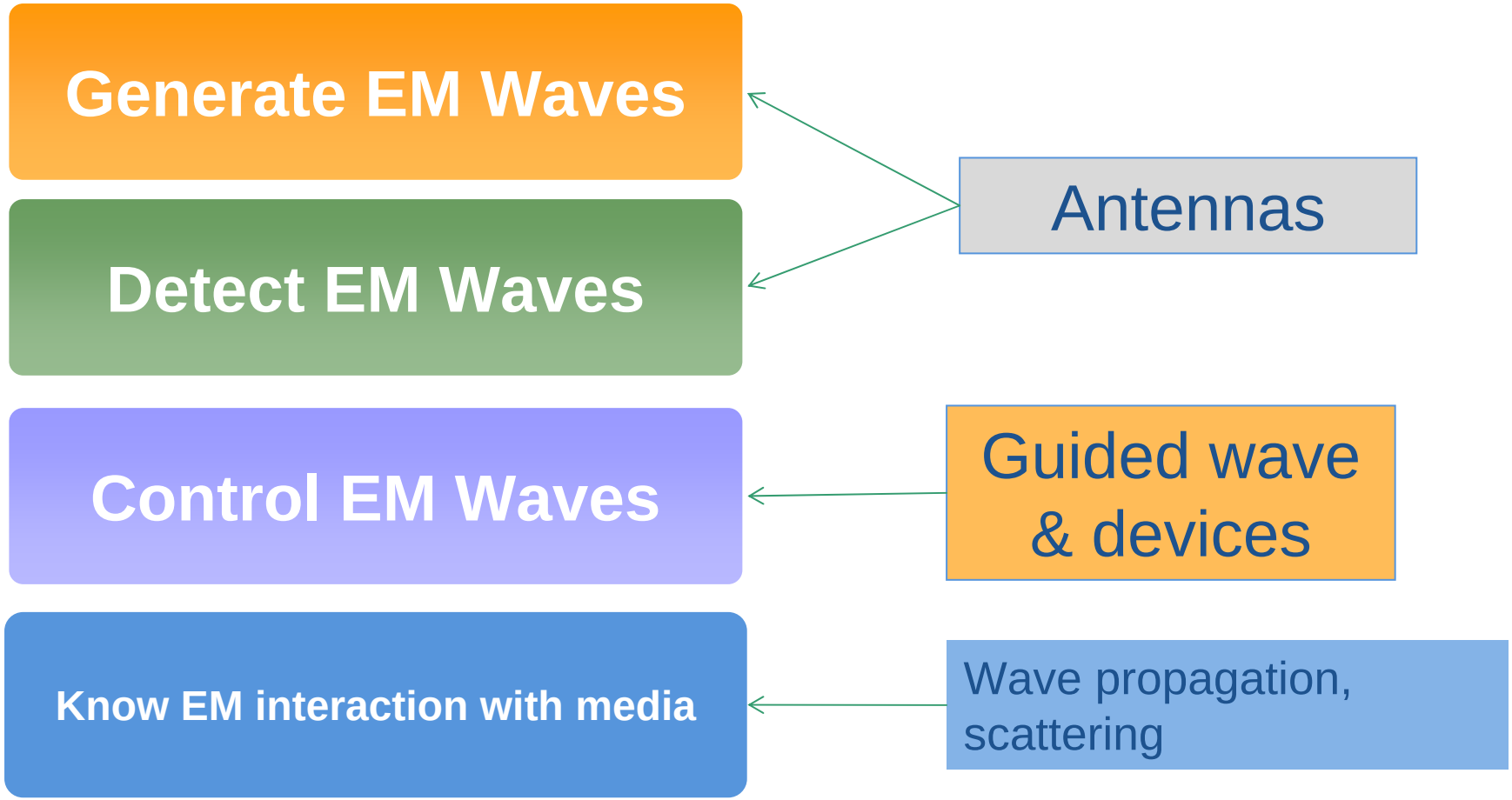
Research area related to electromagnetics



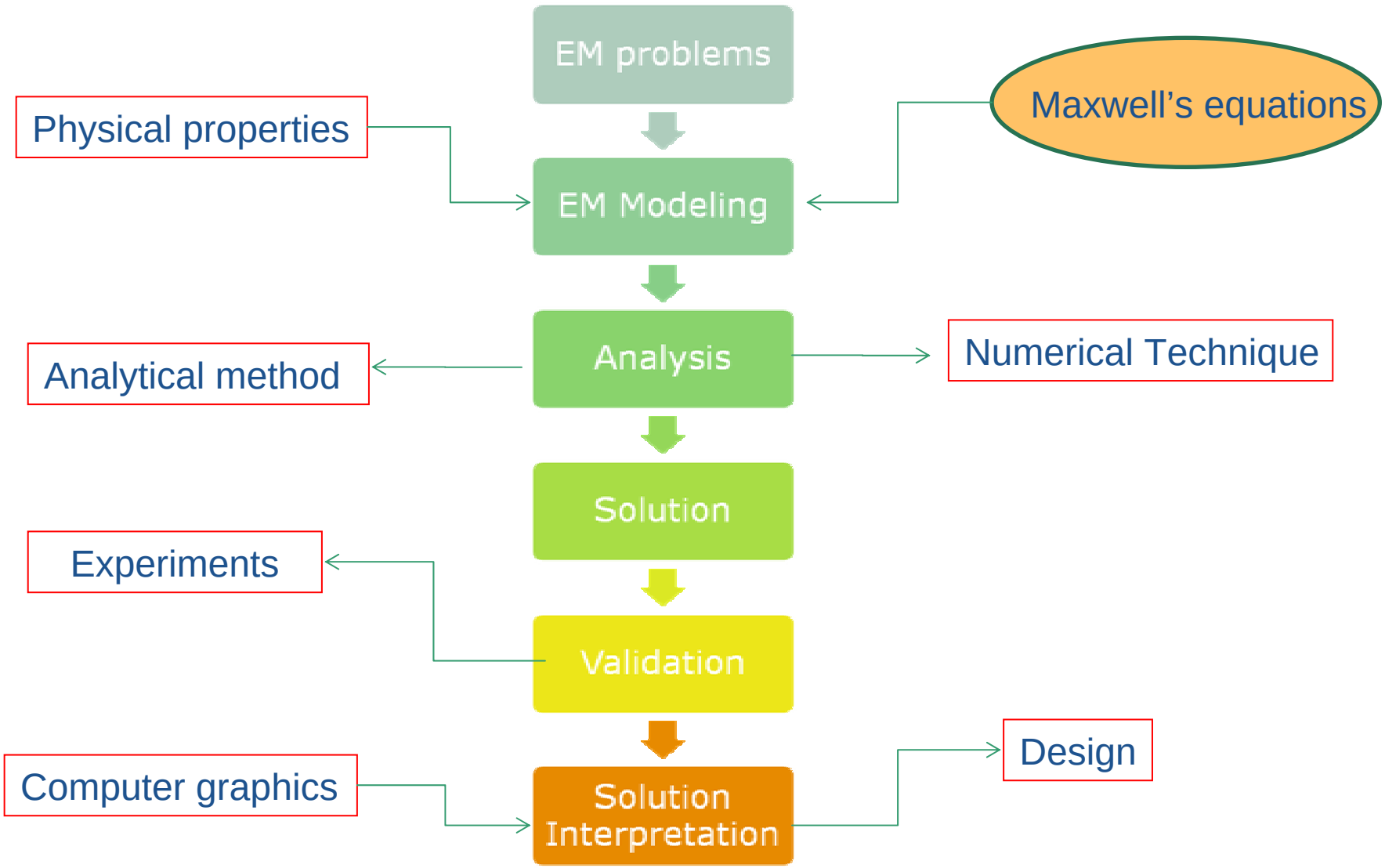
Concept of utilizing electromagnetic waves



From concept to fields of research



Flow diagram for solving EM problems



Major research area in microwave theory and technique

	Research area
1	Linear and nonlinear device modeling
2	Smart antennas, phased arrays, radars
3	Active circuits, semiconductor devices, and integrated circuits
4	Field analysis and guided waves
5	CAD Algorithms and numerical techniques
6	Filters and multiplexers
7	Packaging, Interconnects
8	Instrumentation and measurement techniques
9	Passive circuit elements

Major research area in antenna & propagation

	Research area
1	Antennas
2	Electromagnetics
3	Numerical Methods
4	Propagation
5	Scattering
6	Wireless

My major research field

- **Computational Electromagnetics for Electromagnetic Field Analysis**
  - FEM : Finite Element Method
  - BEM/IE: Boundary Element Method/Integral Equation Method
  - Meshless Method
- **Electromagnetic problems**
  - Microwave waveguides and components
  - Optical waveguides
  - Photonic crystal fibers
  - Photonic crystal waveguides and devices

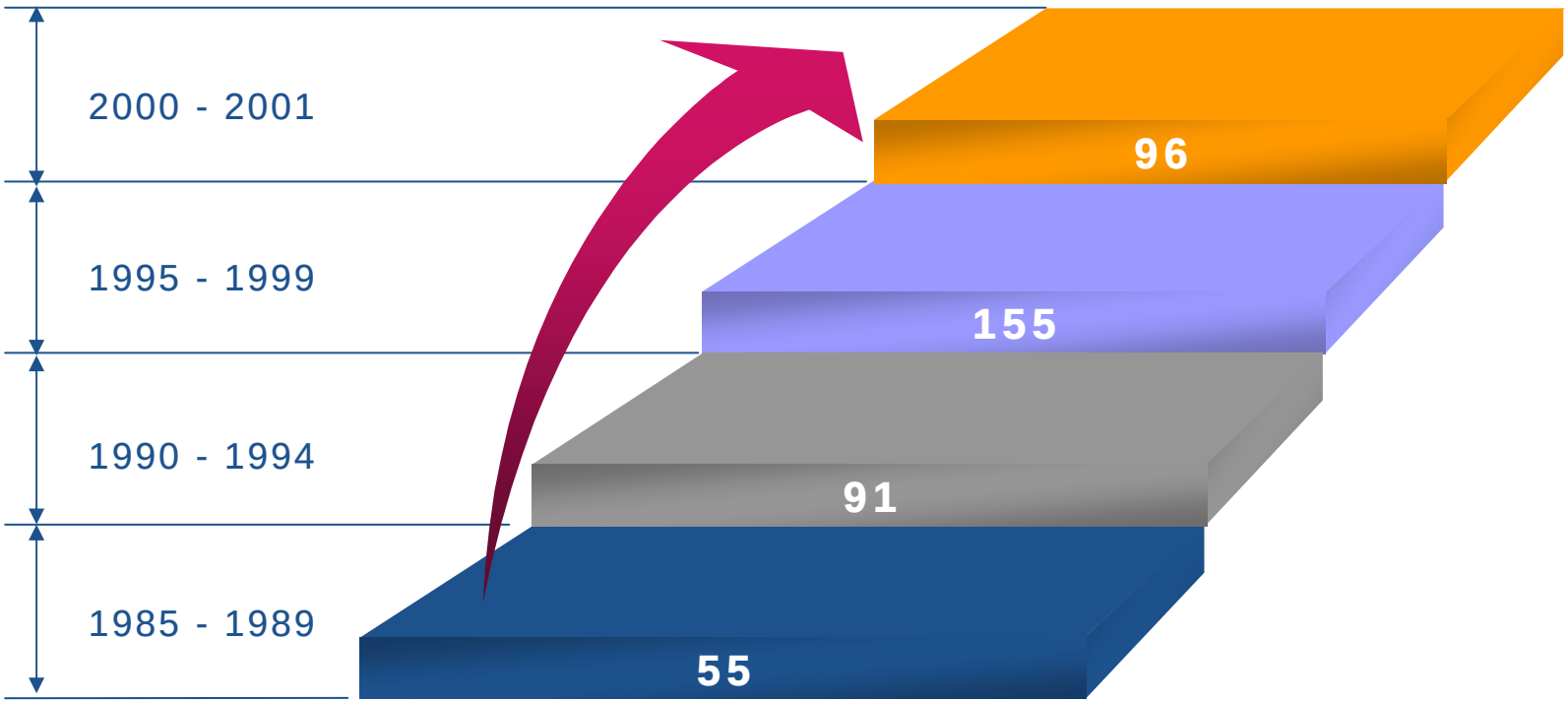
Are women engineers successful in electromagnetics?

Survey of publications

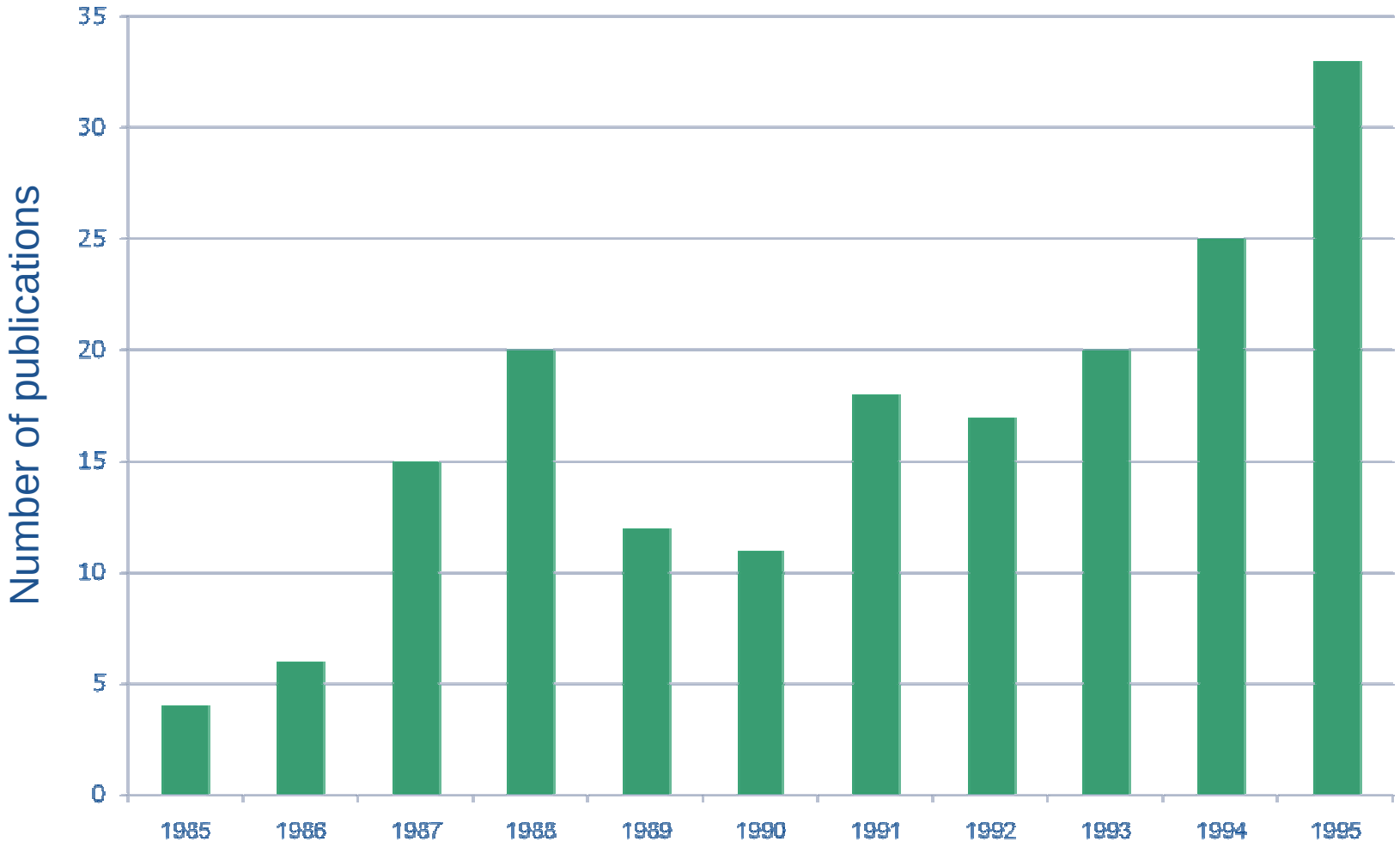
- I have made a survey of publications which women had been authors in IEEE Transaction of Microwave Theory and Techniques (MTT).
- The survey is limited to MTT.
- The survey carried out since 1985 – 2006.
- The data from the survey may give us a clue of involvement of women in this field.

Number of publications in MTT

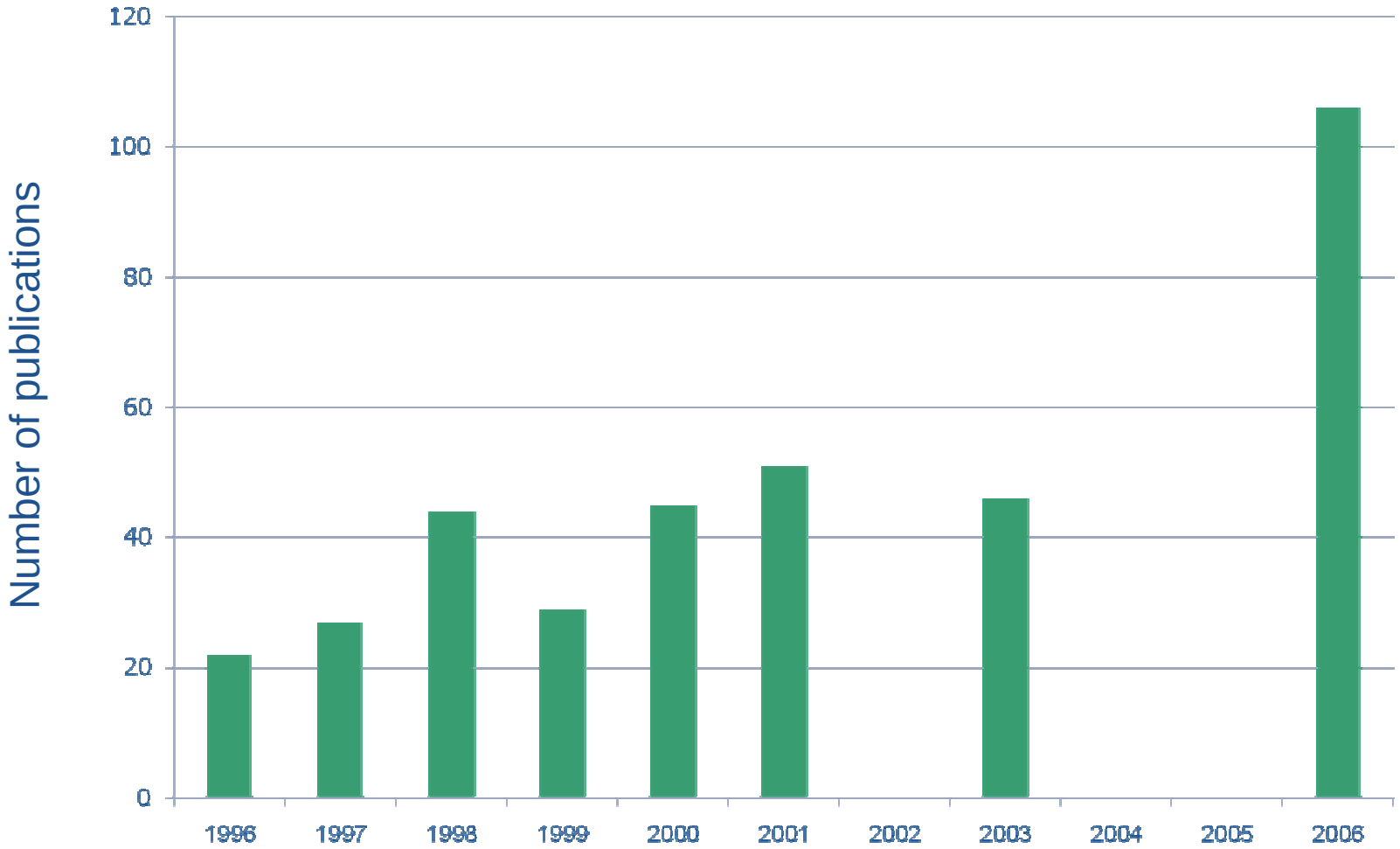
Number of papers published in IEEE Transaction on Microwave Theory and Techniques that has at least 1 woman author



MTT publications in 1985 – 1995 (women authors)



MTT publications in 1996 – 2006 (women authors)



A clue interpreted from the survey data

- **Women engineer had involved in microwave profession in the past 30 years.**
- **Number of paper published by young generation women have been increased every year since 2000.**
- **We may conclude from the history that women engineers are successful in utilizing electromagnetic theory.**
- **Let us find out in detail about successful women engineers in the field of electromagnetics.**

Successful women engineers in electromagnetics

1

1991 IEEE Fellows
Kawthar A. Zaki

for contributions to the analysis of dielectric waveguides and resonators and their applications in microwave filters and oscillators design

2

1995 IEEE Fellows
Linda P. B. Katehi

for contributions to phased array packaging and high-frequency characterization of novel feeding networks for printed antennas and arrays

3

2002 IEEE Fellows
Prof. Zoya Popovic

for contributions to the development of active antenna arrays and quasi-optical power combining techniques

Prof. Kawthar A. Zaki (Education)

Education background

- 1962 B.S. AIN Shams University, Cairo, Egypt
- 1966 M.S. University of California, Berkeley
- 1969 Ph.D. University of California, Berkeley
- All in electrical engineering

Prof. Kawthar A. Zaki (Profession)

Profession Background

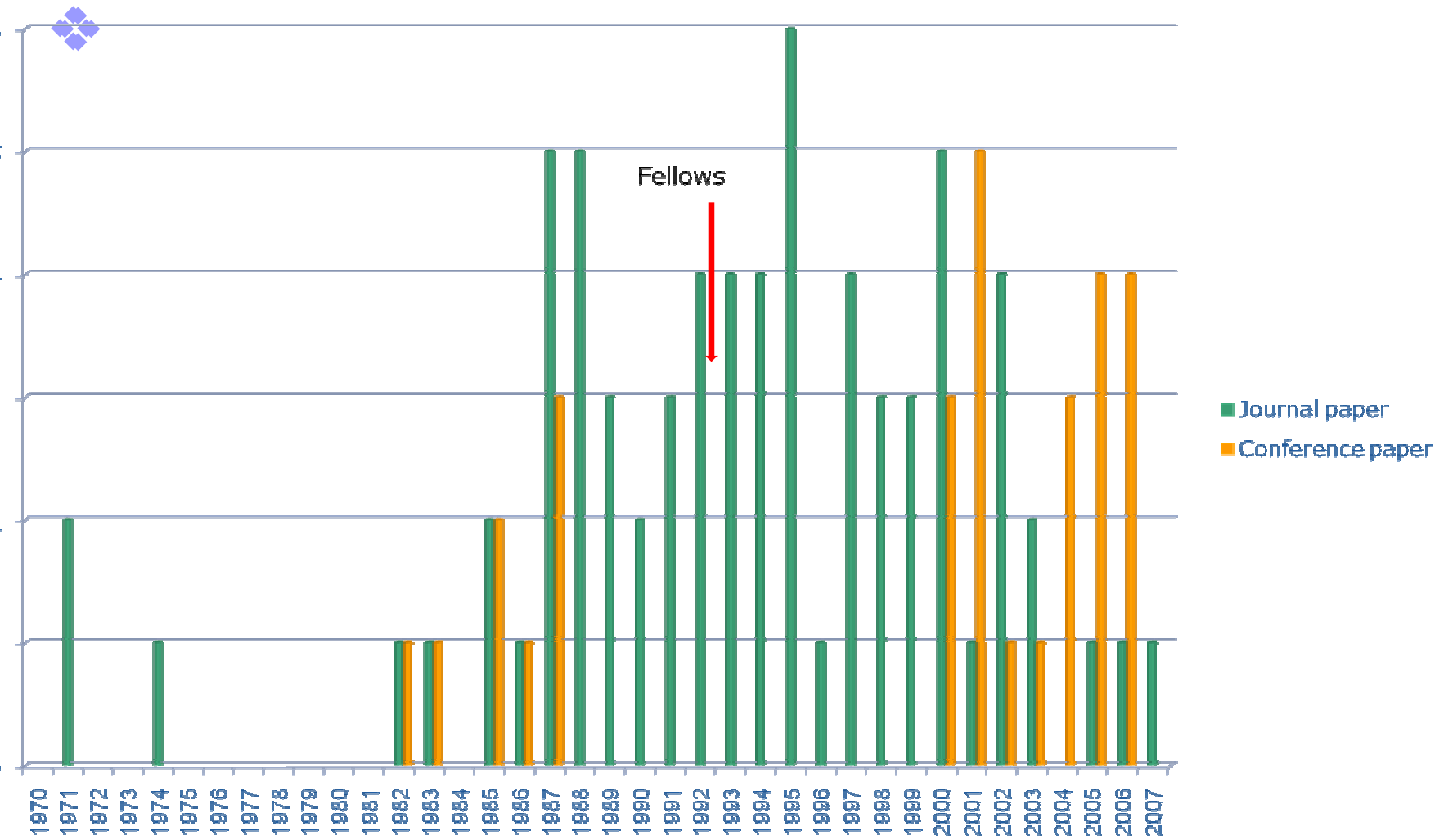
- 1962 – 1964 Lecturer in Department of Electrical Engineering, Ain Shams University.
- 1965 – 1969 Research Assistant in Electronics Research Laboratory, UC Berkeley
- 1970 Join Electrical Engineering Department, University of Maryland, College Park, MD.
- Present Professor Emeritus at Electrical Engineering Department, University of Maryland, College Park, MD.

Prof. Kawthar A. Zaki (Research interest)

- **Research interest :**
  - EM simulation and modeling of microwave circuits Microwaves millimeter waves and optics
- **Most important publication**
  - New Results in Dielectric Loaded Resonators "with C. Chen, IEEE Trans. on Microwave Theory and Techniques, MTT-34, No. 7, pp. 815-824, July 1986"

Quoted from Who's Who in Electromagnetics : The Electromagnetic Academy http://emacademy.mit.edu

Trace her research publications in IEEE



Prof. Linda P. B. (Education)

Education background

- 1977 B.S. E.E. from the National Technical University of Athens, Greece
- 1981 M.S.E.E. degree from University of California, Los Angeles
- 1984 Ph.D. degree from University o California, Los Angeles
- All in electrical engineering

Prof. Linda P. B. Katehi (Profession)

Profession Background

- 1984 She jointed the faculty of EECS department of University of Michigan, Ann Arbor as Assistant Professor.
- 1989 She had been promoted to Associate Professor at University of Michigan Ann Arbor
- 1994 She had been promoted to Professor at University of Michigan, Ann Arbor
- 2002 She joined Purdue University as the John A. Edwardsson Dean of Engineering and Professor of the EECE department.

Prof. Linda P. B. Katehi (Research interest)

- **Research interest :**
- Research Microwave, Millimeter Printed Circuits;
- Development and Characterization of Micromachined Circuits for Microwave, Millimeter-wave and Submillimeter-wave Applications including MEMS Switches, High-Q Evanescent Mode Filters
- MEMS Devices for Circuit Reconfigurability.

Prof. Linda P. B. Katehi

Honors

- Presidential Young Investigator Award from the National Science Foundation and a Humboldt Research Award.
- In 1995, she was named a fellow in the Institute of Electrical and Electronic Engineers (IEEE),
- In 2002 received the Distinguished Educator Award from the IEEE Microwave Theory and Techniques Society.
- In 2004, she received the Leading Light Award for Women in High Tech from the state of Indiana.

Prof. Zoya Popovic (Education)

Education background

- 1985 Dipl.Eng. degree from the University of Belgrade, Serbia, Yugoslavia,
- 1990 Ph.D. from Caltech

Prof. Zoya Popovic (2)

- Popovic came to the United States and earned her PhD at Caltech in 1990, just as her native country entered a period of severe ethnic conflict and political fragmentation.
- She joined the faculty at Corolado University-Boulder, where she has developed several undergraduate and graduate electromagnetics and microwave laboratory courses, and established a strong, active research group.

Prof. Zoya Popovic (Research interest)

Research interest :

- Active Antenna Arrays for Quasi-Optical Power Combining
  Active Lens Antenna Arrays
  High-Efficiency Microwave Circuits
  Antennas for Radio Astronomy
  Smart Antennas
  RF Photonics
  Other Quasi-Optical Components
  New Weird Antennas

Prof. Zoya Popovic (Research interest)

Her research area

- **Designs new antennas and circuits that work in the microwave and millimeter-wave range for applications in wireless communications, radar, and optical communications and processing.**

Prof. Zoya Popovic

Family Legacy in electromagnetics

Professor Zoya Popovic can trace her interest in electromagnetics back to her late father, Branko Popovic, who taught electrical engineering at the University of Belgrade, Serbia for some 40 years.

She took his course in electromagnetics as part of her Dipl. Eng. degree there and went onto become a world-renowned expert in microwave antennas and circuits.

Prof. Zoya Popovic (Honor)

- **Honor**
- **Popovic holds the Hudson Moore Jr. Professorship in Engineering**
- **She is an IEEE Fellow**
- **She is the recipient of several prestigious awards for teaching and research.**
  - the National Science Foundation Presidential Faculty Fellow Award,
  - the American Society for Engineering Education Frederick E. Terman Gold Medal,
  - the International URSI Issac Koga Gold Medal,
  - the Eta Kappa Nu
  - Professor of the Year award from her students.

Prof. Zoya Popovic (Family)

- **Popovic's husband, CU physics Professor Dana Anderson, often collaborates with her on research as well, and their three daughters all know how to solder and have built their own radios.**

Concluding Remarks

- **Women in electromagnetics have made a remarkable contributions in research and engineering profession since 30 - 40 years ago.**
- **Research fields related to electromagnetics are not boring or difficult areas for women to choose as a profession.**
- **Note that we have 3 Women IEEE Fellows at present time. I hope that we will have more women received IEEE Fellows in the future.**

7 Rules for Success

- Be passionate about what you do
- Establish goals
- Set priorities
- Network up and down
- Communicate well and often
- Hone your skills
- Get a life

From Tuptim Angkaew, 28 July 2007