

# FUMIO'S ROBOTICS

## Past, Present and Future



**Robotics in the XXI. Century:  
New Frontiers**

**International Colloquium, dedicated to  
the 85th birthday of Tony Bejczy.  
16-17. February, 2015 at Óbuda University**

**Fumio Harashima  
Tokyo Metropolitan University**

# ASTRO BOY/MIGHTY ATOM



**The first robot Fumio met  
in 1951**



1945

# The end of the war August 15, 1945

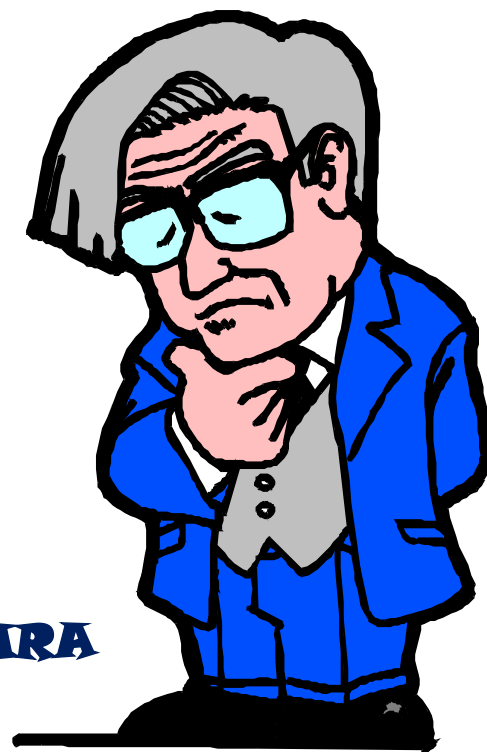


# PERSONAL MEMORY OF SIXTY YEARS

AGO — 1950

MY FATHER TALKED  
TO HIS CHILDREN  
60 YEARS AGO

60年前の思い出



鮮  
AKIRA



**Democracy**

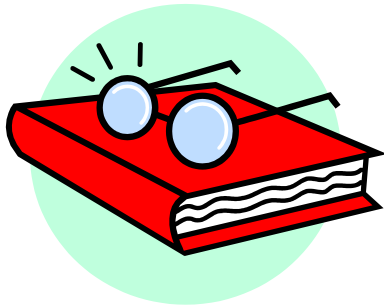
**Justice**

**Science and  
Technology**

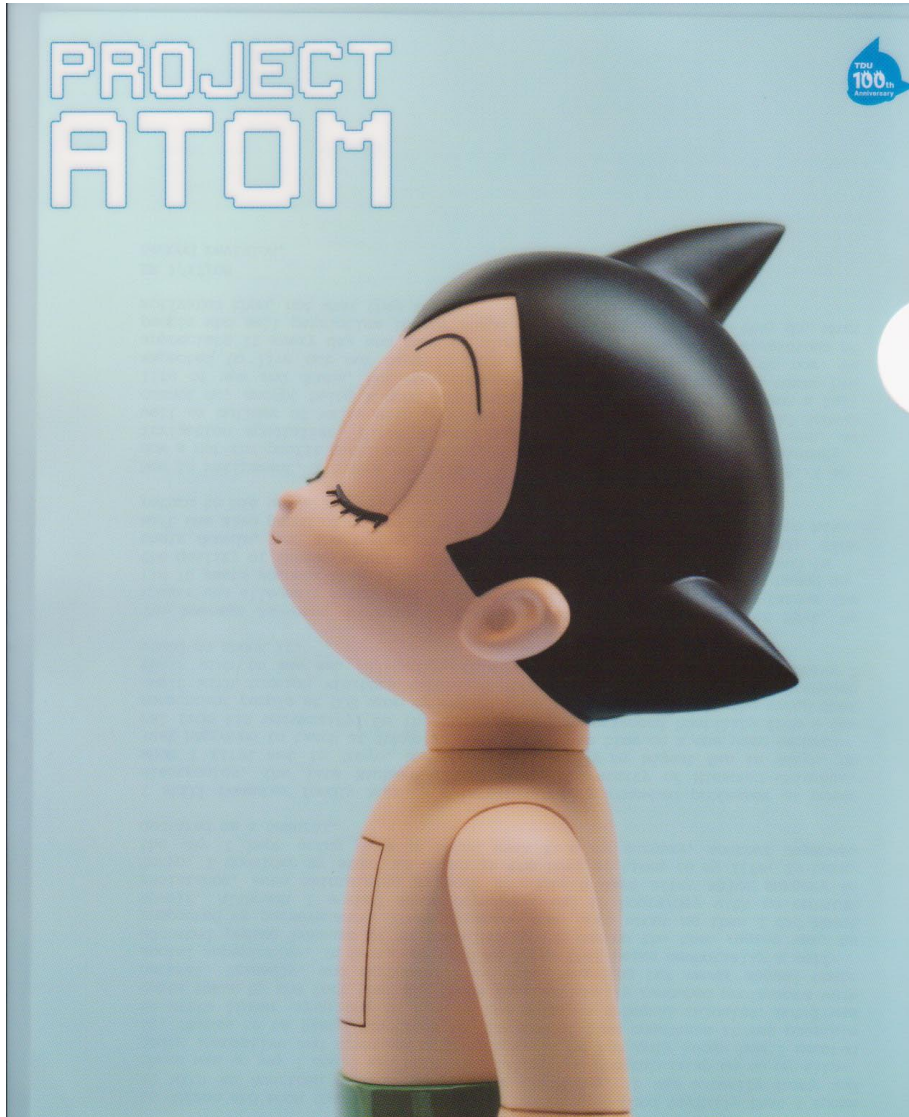
# READING BOOKS

12 years old to present  
One book a day

Wished to be a novelist till the end of high school



# ASTRO BOY/MIGHTY ATOM



**Fumio came back  
to ATOM in 195**



# MAJOR CONCEPT OF “ATOM”

is

“PEACE and JUSTICE”

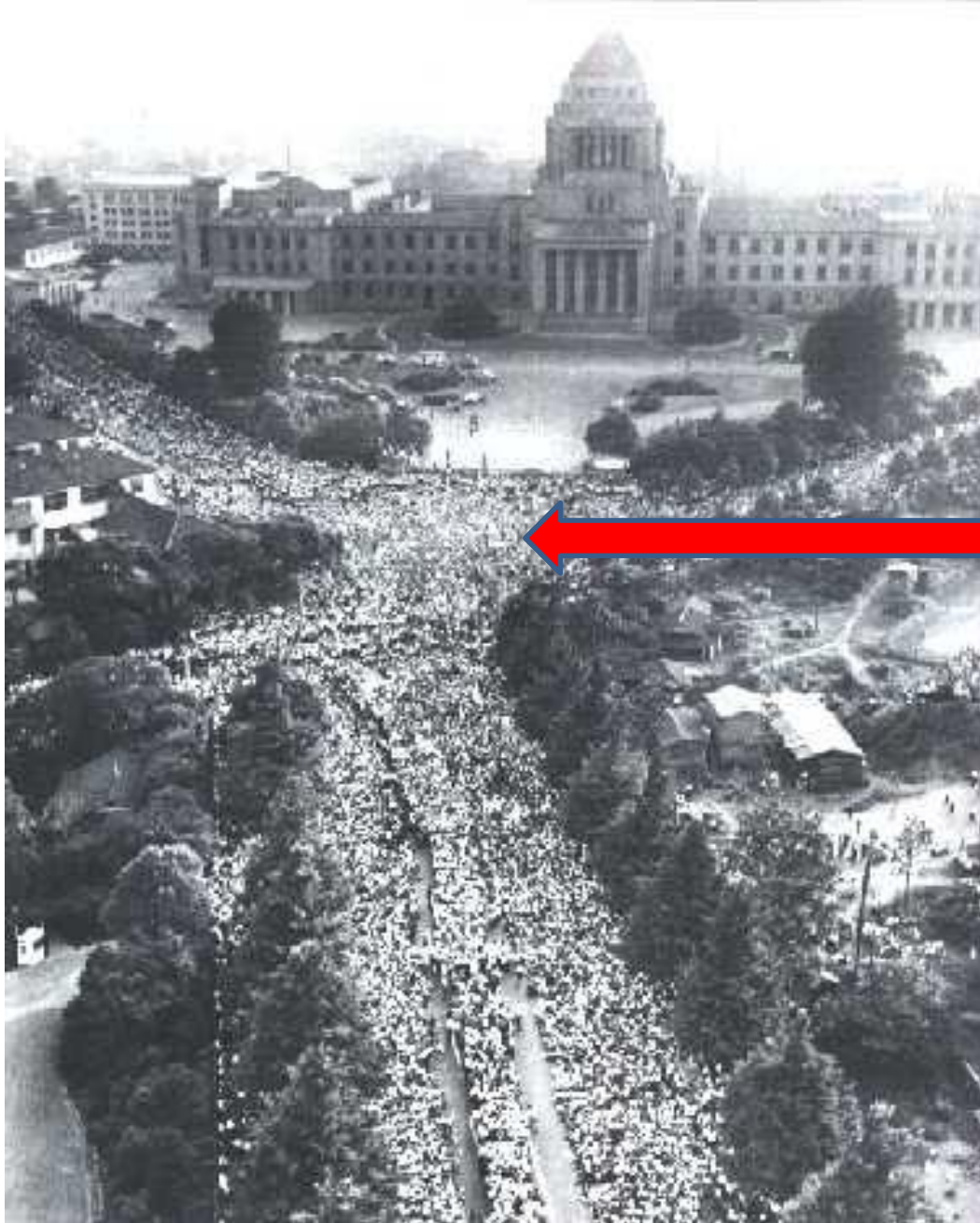


**Control and robotics are most popular among bright students at that t**

Univ. of Tokyo, 1958



**University of Tokyo, 1958**



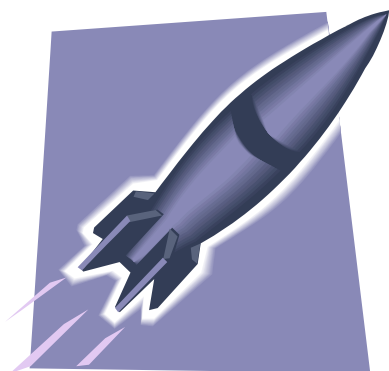
**FUMIO**

June 15, 1960



## **GRADUATE SCHOOL**

**Institute of  
Industrial Science,  
Univ. of Tokyo**



夏の生研研究棟

# RESEARCH FLOW

**2003**

**ADAPTIVE  
MECHATRONICS**

**HUMAN**

**2000**

**AND  
INTELLIGENCE**

**INTERACTION**

**1990**

**ROBOT CONTROL**

**1978**

**CONTROL**

**MANIPULATOR**

**1975**

**MOTION CONTROL**

**1970**

**MOTOR DRIVE CONTROL**

**1967**

**POWER ELECTRONICS**

**CIRCUIT TECHNOLOGY**

# TEAM



**IEEE/INDUSTRIAL  
ELECTRONICS  
SOCIETY 1975-**

**MECHATRONICS**

**ROBOTICS**

**INDUSTRIAL INFORMATICS**

**POWER ELECTRONICS**

# IECON Philadelphia





# PEOPLE

- **Fumio HARASIMA** (IEEE/IES President)
- **Okyay KAYNAK** (IEEE/IES President)
- **Ren Luo** (IEEE/IES President)
- **Toshi FUKUDA** (IEEE/RAS President)
- **Kazuo TANIE** (IEEE/RAS President)
- **Kouhei Ohnishi** (IEEE/IES President)
- **Kazuhiro KOSUGE** (IEEE/RAS President)
- **Richard Zurawski** (EIC, IEEE Trans. Informatics)

# **FORMATION of NEW SOCIETY**

- **Power Electronics Society**
- **Robotics and Automation Society**
- **Tony Bejczy was the Council President in 1987**
- **Fumio Harashima was the IES President in 1986-1987**

# **NEW JOURNALS and CONFERENCES**

---

- **IEEE Trans. on Mechatronics**

T.Fukuda, M.Tomizuka and Ren Luo

- **IEEE Trans. on Industrial Informatics**

R. Zurawski and O. Kaynak

---

- **IEEE/RSJ IROS Conference**

T.Fukuda

- **IEEE ROMAN Conference**

H. Kobayashi

- **IEEE/ASME AIM Conference**

H.Hashimoto

- **IEEE AMC Conference**

K. Ohnishi

- **IEEE ETFA Conference**

R.Zurawski

# MOST SUCCESSFUL IROS 2011



# Top journals in engineering 2011 MICROSFT

[IEEE TRANS IND ELECTRON - IEEE Transactions on Industrial Electronics](#)

[RENEW SUSTAIN ENERGY REV - Renewable & Sustainable Energy Reviews](#)

[APPL ENERG - Applied Energy](#)

[IEEE TRANS AUTOMAT CONTR - IEEE Transactions on Automatic Control](#)

[IEEE TRANS POWER ELECT - IEEE Transactions on Power Electronics](#)

# *Physical Interaction (final keyword)*



# HAYABUSA

Space robot, first sample return  
from the space



Launching, May 9, 2003



Asteroid "Itokawa", Summer, 2005



Satellite "Hayabusa"



June 13, 2010

# **FUTURE of ROBOTICS**

**Fumio's family discussed in 2000**

**“How will be the future of human society ?”**

## **CONCLUSION:**

**The key issues will be.**

- Health and Safety**
- Justice**



# CHILDREN



# THE QUESTION is

**What is Robotics for Health,  
Safety and Justice?**



# **ROBOTICS for HEALTH**

- **Surgery Robot**
- **Medical micro-robotics and instrumentation**
- **Nursing Robot**
- **Power assist, Transfer Robot**
- **Mental Care Robot**

# EXAPLES



da Vinci Surgical System



Power assist, Transfer Robot

# EXAMPLES



**Hospital Patrol Robot**



**Mental Care Robot PARO**

# Remote-Paro at a Living Room for Psychological Experiment

## Intelligence

32 bit RISC CPU

Behavior Generation

3D Sound Localization

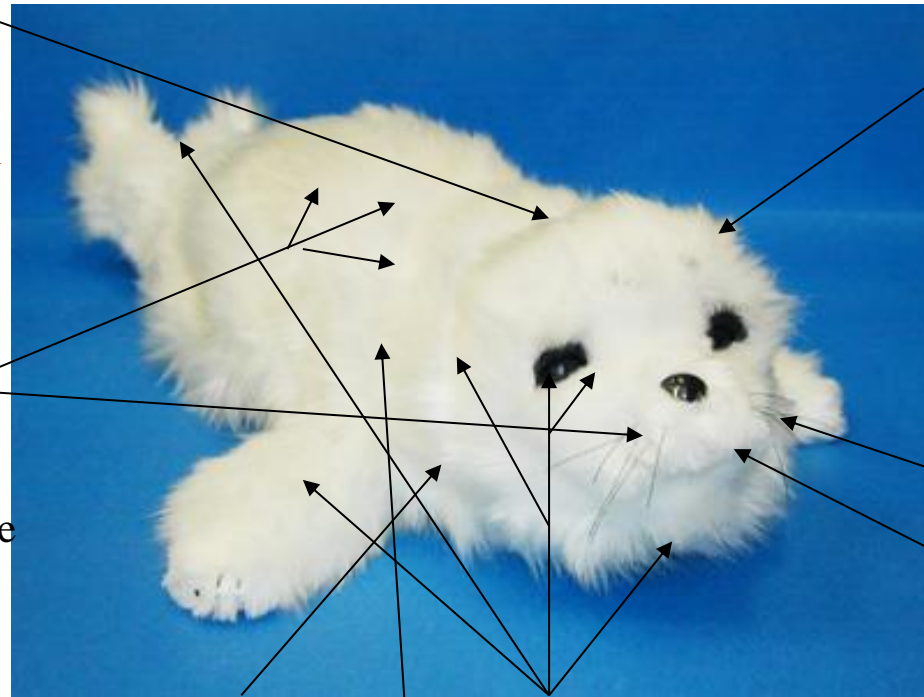
Speech Recognition  
(Name Learning)

## Tactile

12 Ubiquitous Surface  
Tactile Sensor

Stereo Whisker Sensors

Anti-Bacterial  
Artificial Fur



## Audition

3 Microphones

Speaker

Charging  
Battery

## Posture

3 Axis Acceleration

## 7 Actuators

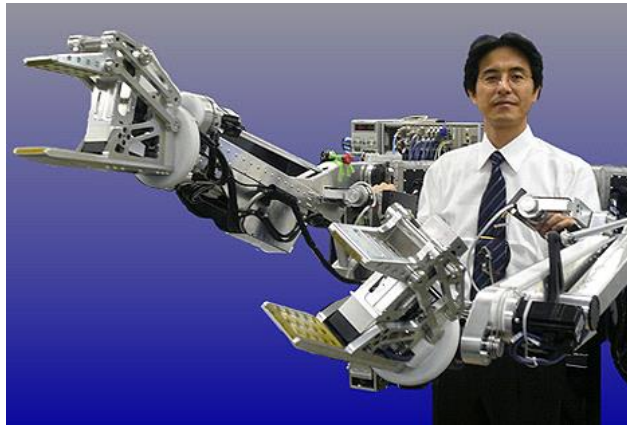
2 for Neck, 2 Front Legs, 1 Back Leg, 2 Eyes

Temperature at CPU, Battery, and Each Actuator

# PROSTHESIS



# ROBOT HOSPITAL ???



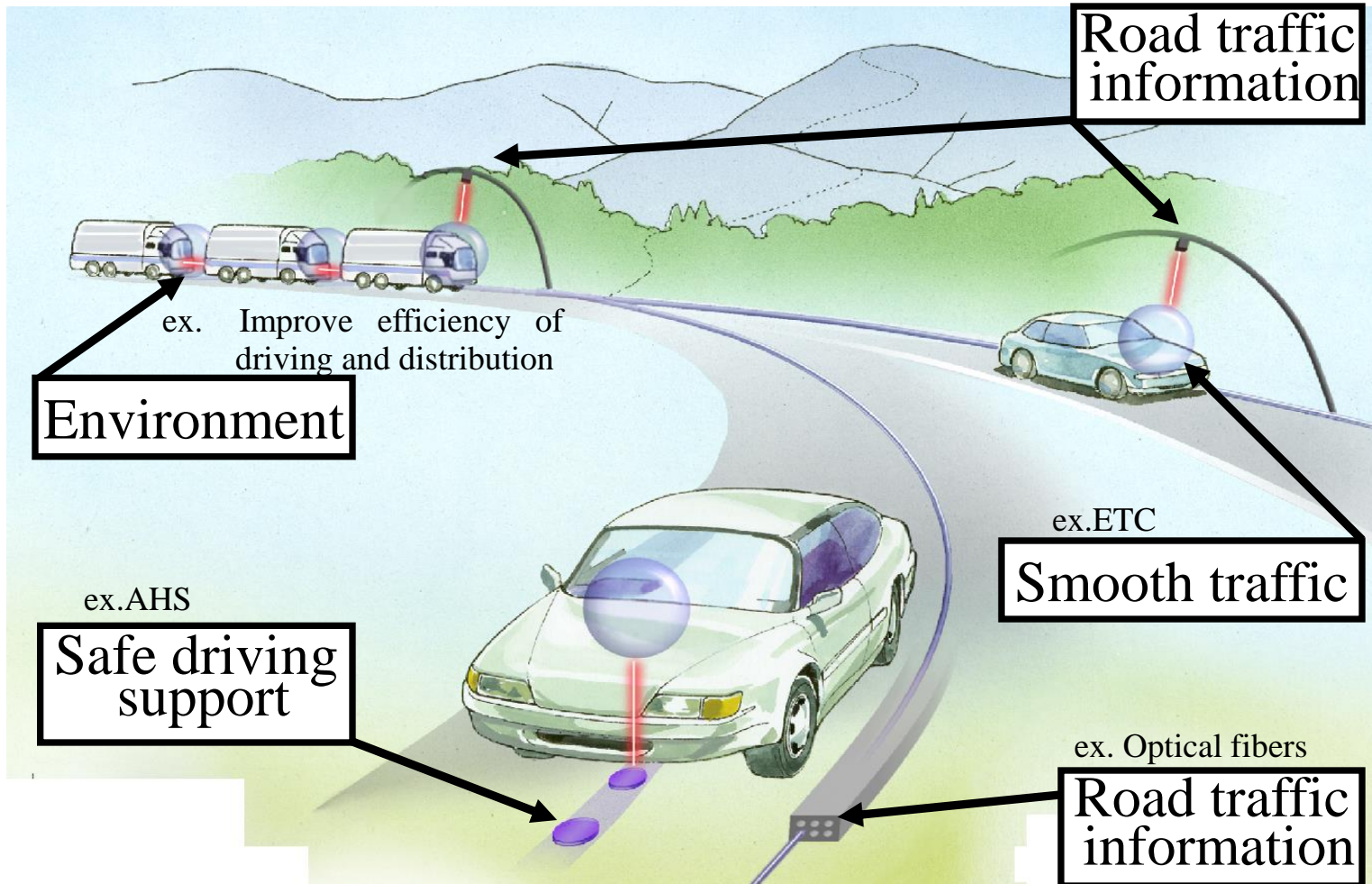


# ROBOTICS for SAFETY

**ROBOT CAR**



# Smart Driving



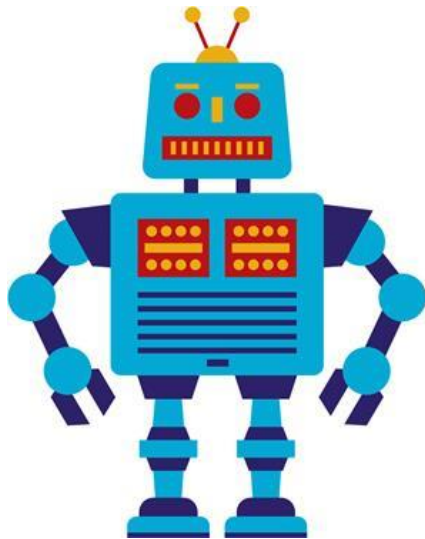


**MOST DANGEROUS ROBOT**

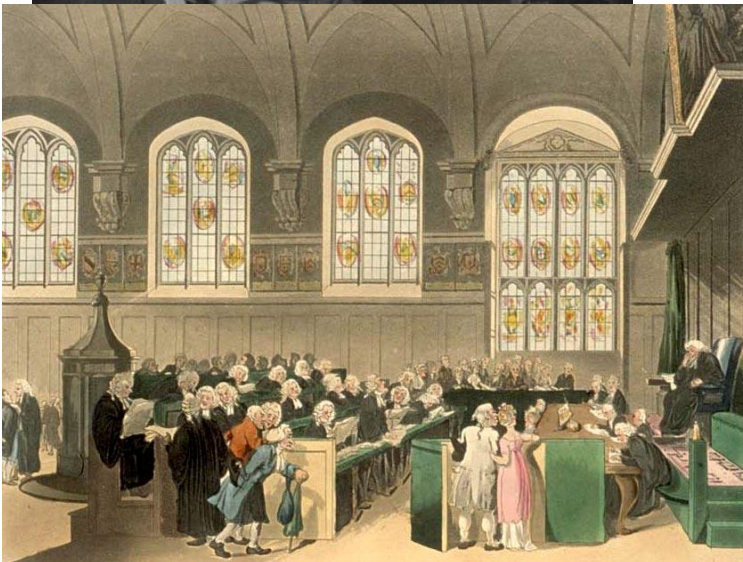
# **ROBOTICS in JUSTICE**

- **Police robot**
- **Detective robot**
- **Scientific criminal investigation**
  
- **Robot in court house ?**  
**Judge, Procurator,**  
**Lawyer ?**

# POLICE ROBOT



# ROBOT in COURT HOUSE ??



**It is not easy to imagine  
court robot**

# CONCLUSIONS

- PAST
- PRESENT
- FUTURE

# PAST

**Science and Technology  
in past centuries  
liberated people from**

**“Physically Painful  
Labor”**



# GOAL in 2050

**Science and technology in  
21<sup>st</sup> century  
liberates people from**

**“Mentally Painful  
Labor”**



## OUR GOAL

**Beautiful,  
Intelligent Human  
life  
which is fully  
supported  
by science and  
technology**



**THANK  
YOU !**