
KAUNO
TECHNOLOGIJOS
UNIVERSITETAS

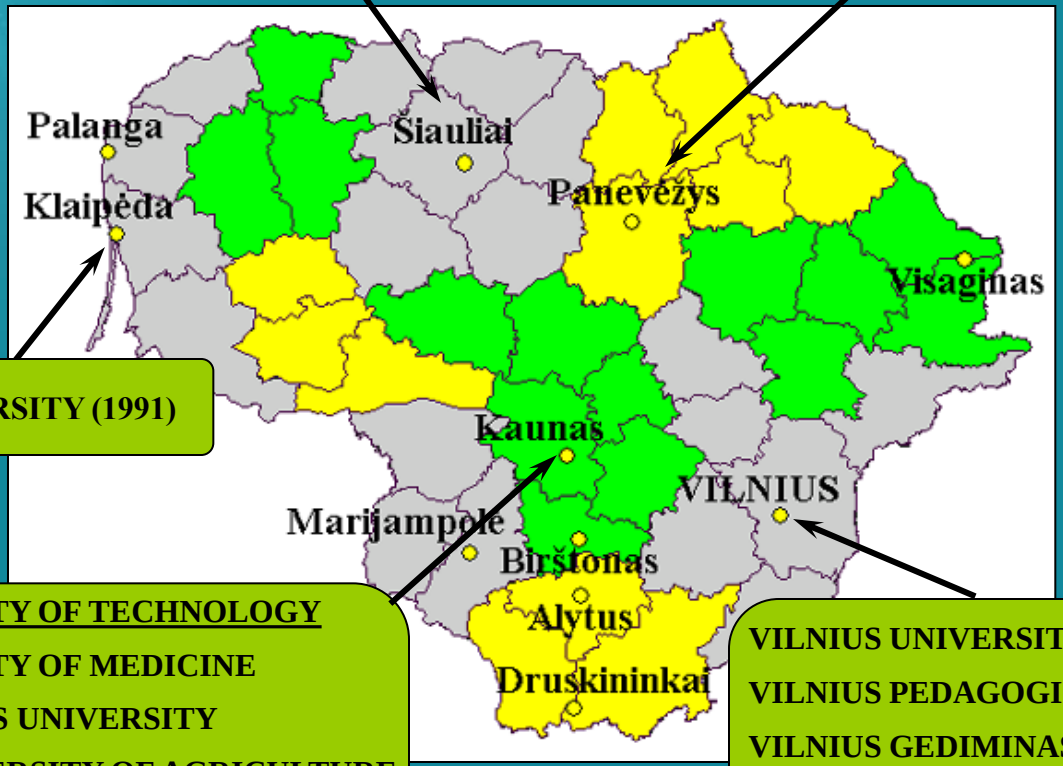
# Innovations in Engineering Programs: Impact on Quality

Prof. dr. habil. Ramutis BANSEVICIUS

*Paris, 22 – 23 September 2005*

ŠIAULIAI UNIVERSITY (1998)

KAUNAS UNIVERSITY OF TECHNOLOGY BRANCH (1998): PANEVĖŽYS INSTITUTE




KLAIPĖDA UNIVERSITY (1991)

<u>KAUNAS UNIVERSITY OF TECHNOLOGY</u>
KAUNAS UNIVERSITY OF MEDICINE
VYTAUTAS MAGNUS UNIVERSITY
LITHUANIAN UNIVERSITY OF AGRICULTURE
LITHUANIAN VETERINARY ACADEMY
LITHUANIAN ACADEMY OF PHYSICAL EDUCATION
LITHUANIAN INSTITUTE OF ENERGY

VILNIUS UNIVERSITY
VILNIUS PEDAGOGICAL UNIVERSITY
VILNIUS GEDIMINAS TECHNICAL UNIVERSITY
LAW UNIVERSITY OF LITHUANIA
LITHUANIAN ACADEMY OF MUSIC
LITHUANIAN ACADEMY OF ART
LITHUANIAN ACADEMY OF WAR

- The biggest technical university in Lithuania and in the Baltic States
- More than 50 years of scientific and educational experience
- In the last 10 years - increased attention to innovations commercialization and SMEs support

# University structure

**Faculties**

of
Chemical Technology
Civil Engineering and Architecture
Design and Technologies
Economics and Management
Electrical Engineering and Control Systems
Fundamental Sciences
Humanities
Informatics
Mechanical Engineering
Social Sciences
Telecommunications and Electronics
KTU Panevėžys Institute
  Faculty of Management and Adm.
  Faculty of Technologies
International Studies Centre

**Research Institutes**

of
Europe
Environmental Engineering
Metrology
Piezomechanics
Material Science
Defence Technologies
Biomedical Engineering
Prof. K.Baršauskas Ultrasound R.In.
Technological Systems Diagnostics
Information Technology Devel. In.

**Library**

**Centres**

of
Microsystems and Nanotechnology
**Computational Technologies**
Packaging Research Centre
Physical Education and Sports
Kaunas Regional Distance Education Centre

*Founder*

**Institute of America**
**Institute of Architecture and Civil Engineering**
**Food Institute of Lithuania**
**Institute of Physical Electronics**

# High-Tech Priorities

| 6 FRAMEWORK | USA | Lithuania |
|---|---|---|
| •Life sciences, genomics and biotechnology for health<br>•Information society technologies<br>•Nano-technologies and nano-sciences, knowledge-based multifunctional materials and new production processes and devices<br>•Aeronautics and space<br>•Food quality and safety<br>•Sustainable development, global change and ecosystems<br>•Citizens and governance in a knowledge-based society<br>•Nuclear energy | •Nano-sciences and engineering<br>•Information technologies<br>•Environment and biotechnology<br>•Sensors, security, energy, infrastructure<br>•Education and development human resources | •Biotechnology<br>•Optoelectronics (lasers)<br>•Information technologies<br>•Mechatronics<br>•Nano-technologies and electronics |

USA sciences and studies foundation – 61,95 billion $

# INOVATIONS IN STUDIES

Innovation depends on good ideas and smart people.

To encourage it over the long run,  the best course is to increase Government  funding for research and spend more on graduate education in science and engineering

# INNOVATIONS IN STUDIES

How to get younger people earlier on in their lives excited about technology or innovations?

# Important factors

- The interest in Technology among young people is declining (not only in Lithuania);
- Modern technological gadgets are pretty complicated (even toys!)

# The Role of the Secondary Schools

- Science Museums in London, Oslo, Copenhagen,…
- Hands-on experience in labs;
- Technical creativity groups in schools or inside University;
- Popular Science periodicals.

Studies reported in *Scientific American* show that people with a high ‘’EUREKA” ability all have at least moderate intelligence.

But beyond that, there seems to be no correlation between high intelligence and the ability to envision simple solutions for complex problems

-The telegraph was created by Samuel Morse, portrait painter;

- The Wright brothers were bike mechanics;

-The ballpoint pen was invented by a sculptor.

**But is this trend continuing today?**

# The total amount of knowledge doubles in 7 (or 5?) years

- University is a conservative institution!
- Future of text books, libraries, laboratories;
- Free e-textbooks (very often renewable) for all; e-courses in KTU;
- INTERNET in laboratory works.

It’s one thing to be a creative thinker and it’s quite another thing altogether to inspire an entire roomful of people to be fresh thinkers

Tom Monaham. The do-it-yourself lobotomy, 2002

Many ideas grow better when transplanted into another mind than in the one where they sprung up

Oliver Wendell Holmes Jr

# How to improve student's ability to think creatively ("innovative thinking")?

- interdisciplinary courses (e.g. Mechatronics, Medical Engineering, Sport's Engineering, Music Technologies…);
- creative laboratory works;
- problems with:
    - vaguely formulated tasks;
    - data not fully described;
    - ambiguity;
    - real practical applications (from Industry, etc.);
    - group work with specified function for each member;
    - closer contacts with social partners.

# STUDY COURSE ON INNOVATIONS

- obligatory for technological universities in former USSR;

- a lot of existing methodologies: from lateral thinking (Edward de Bono), 180 degrees thinking (Tom Monahan) to MegaCreativity (A.Aleinikov).

**‘’The question is not what you look at, but what you see’’**

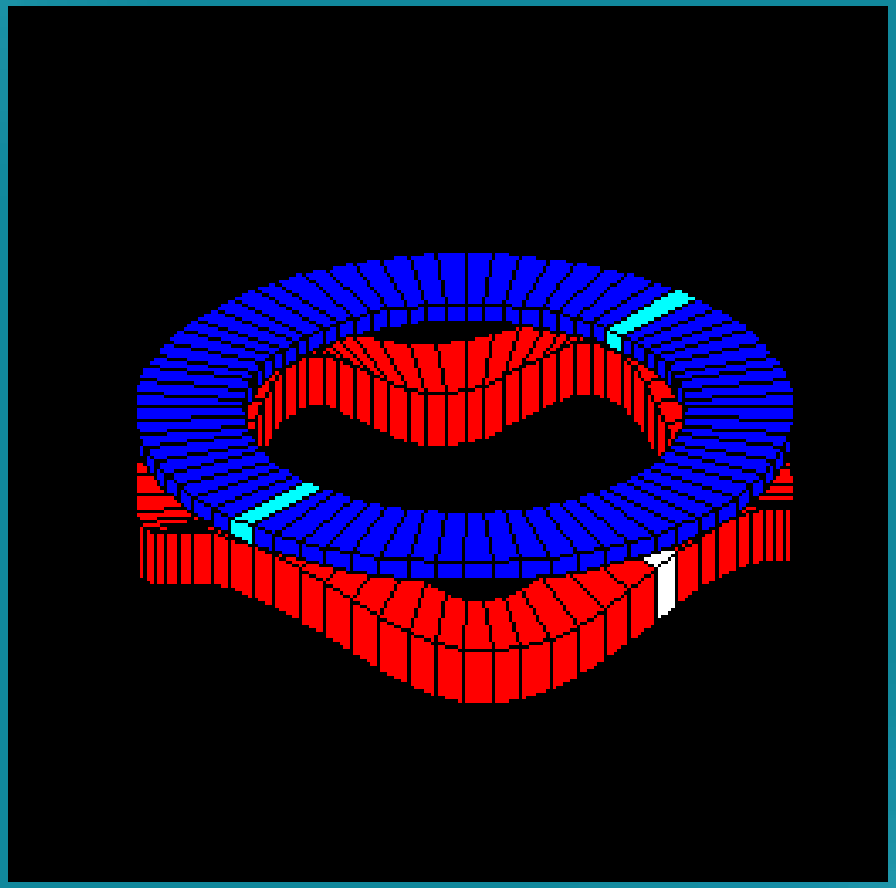
Henry David Thoreau

# Some examples of stimulating innovative approach in teaching

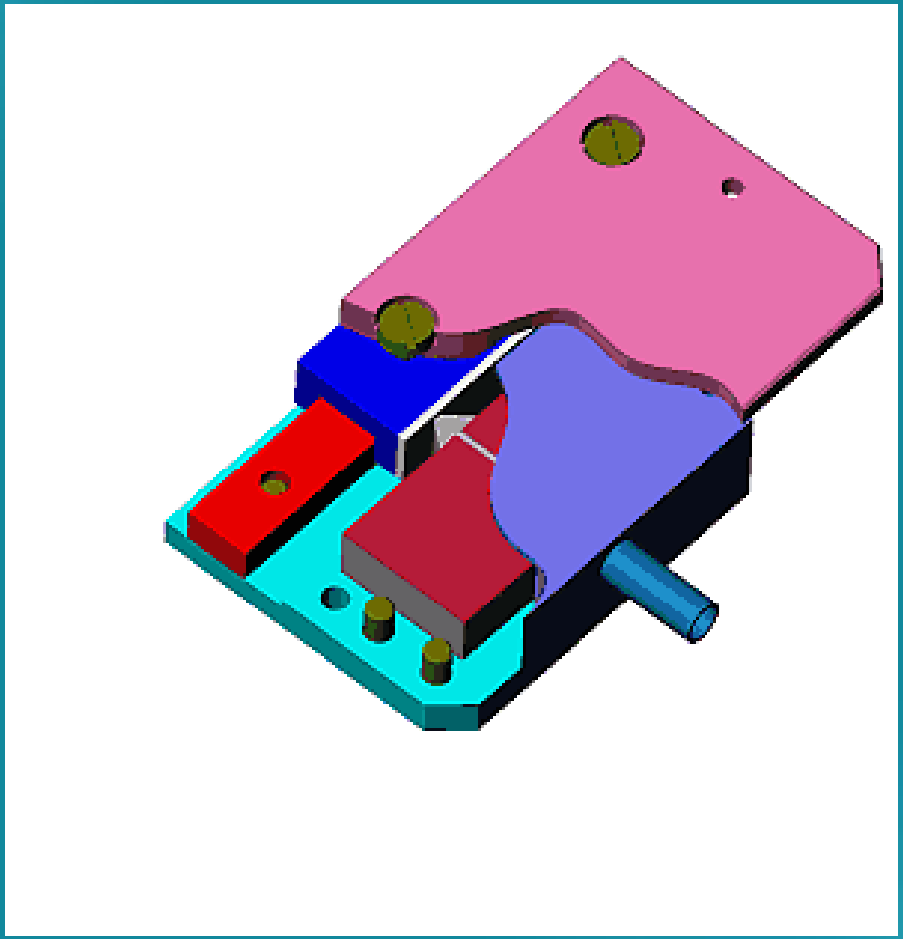
# “MECHATRONICS AND INTELLIGENT MECHANISMS”

# Piezoelectric Screw Motor (1980)

# Transformation of traveling wave oscillations into continuous motion



# Transformation of two component oscillations into linear motion



# Smart Piezoelectric Actuators

*1. Transformation of oblique impacts into continuous motion*

*2. Application of curvilinear waveguides*

*3. Linear piezomotor: demonstration of phase shift between longitudinal and transverse oscillation*

## Smart Piezoelectric Actuator

*1. Two active elements in a contact zone*

*2. Radial traveling wave piezomotor*

*3. The concept of Active bearing*

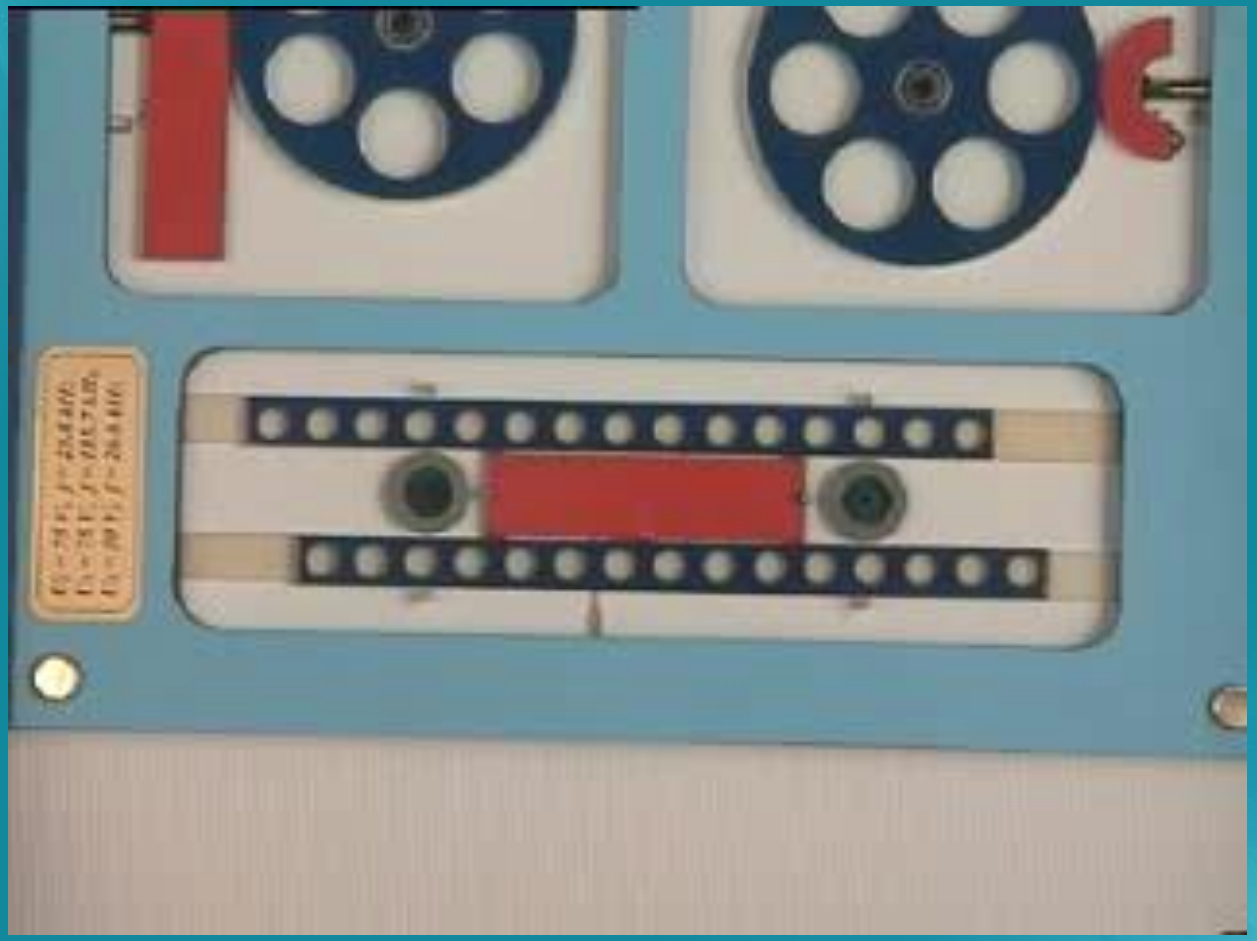
## Smart Piezoelectric Actuator

*1. Axial traveling wave piezomotor*

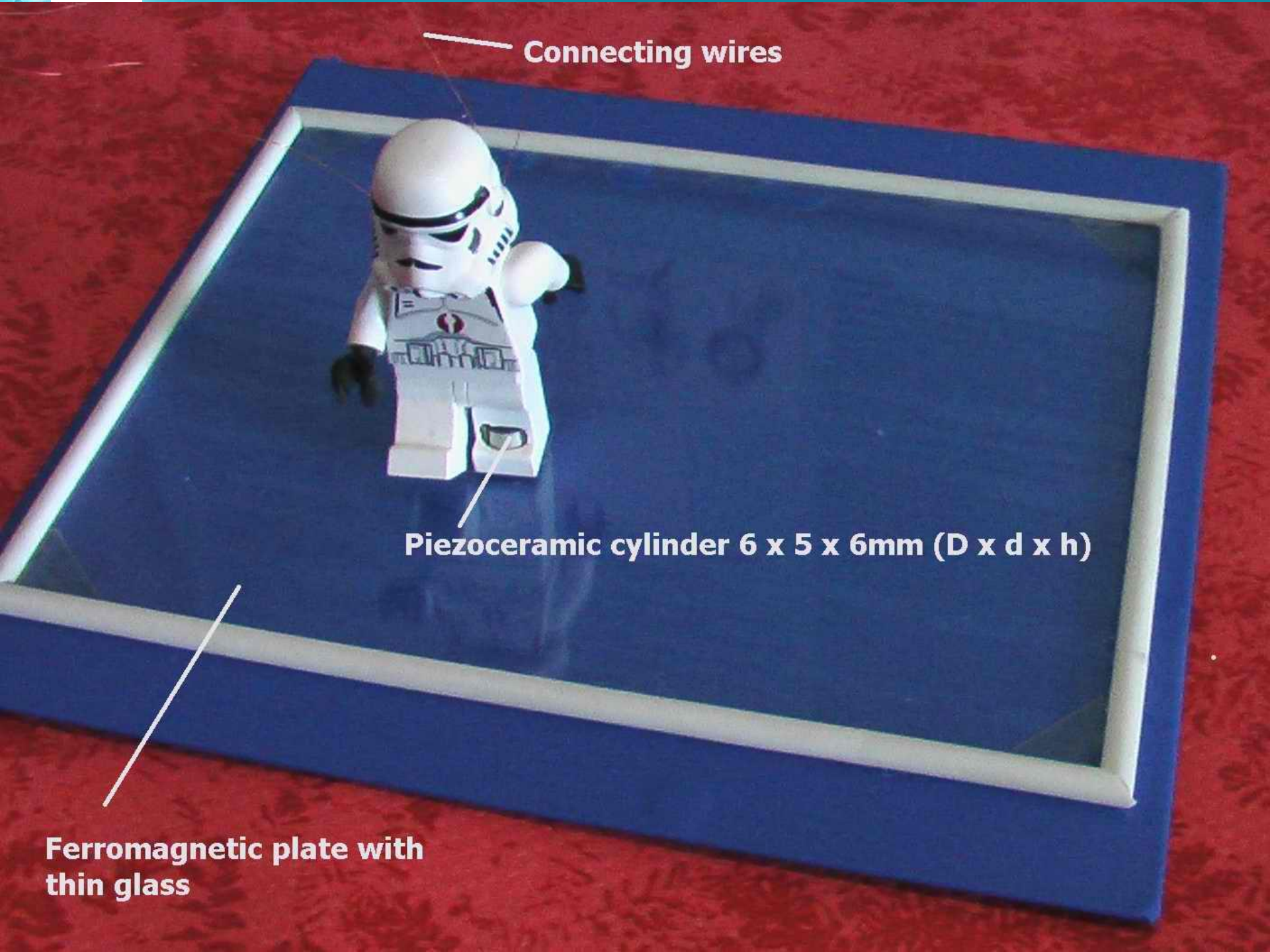
*2. Three degrees-of-freedom (DOF) piezomotor*

*3. Positioning on a plane (3 DOF)*

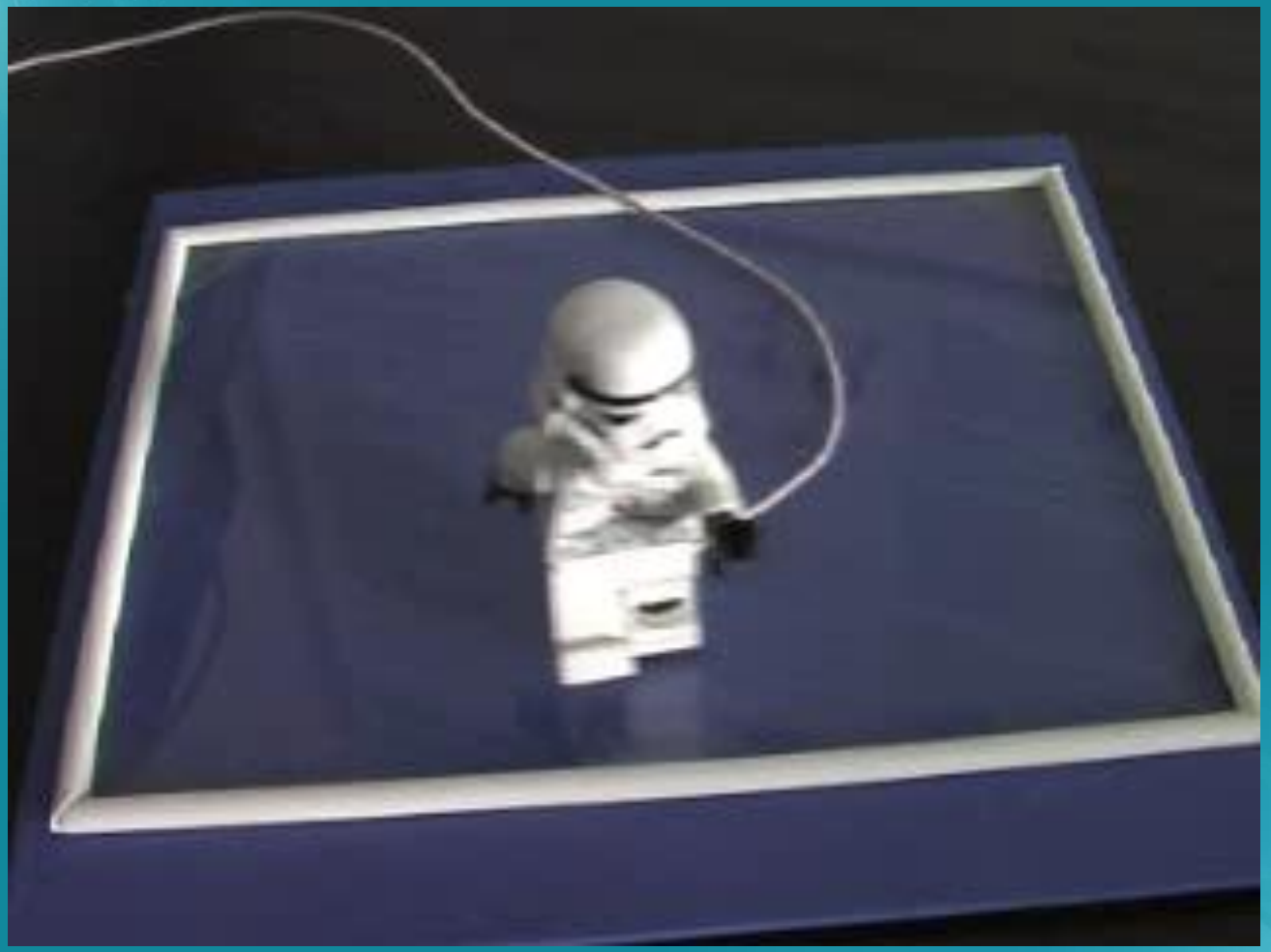
# Illustrating the complicated dynamic problem

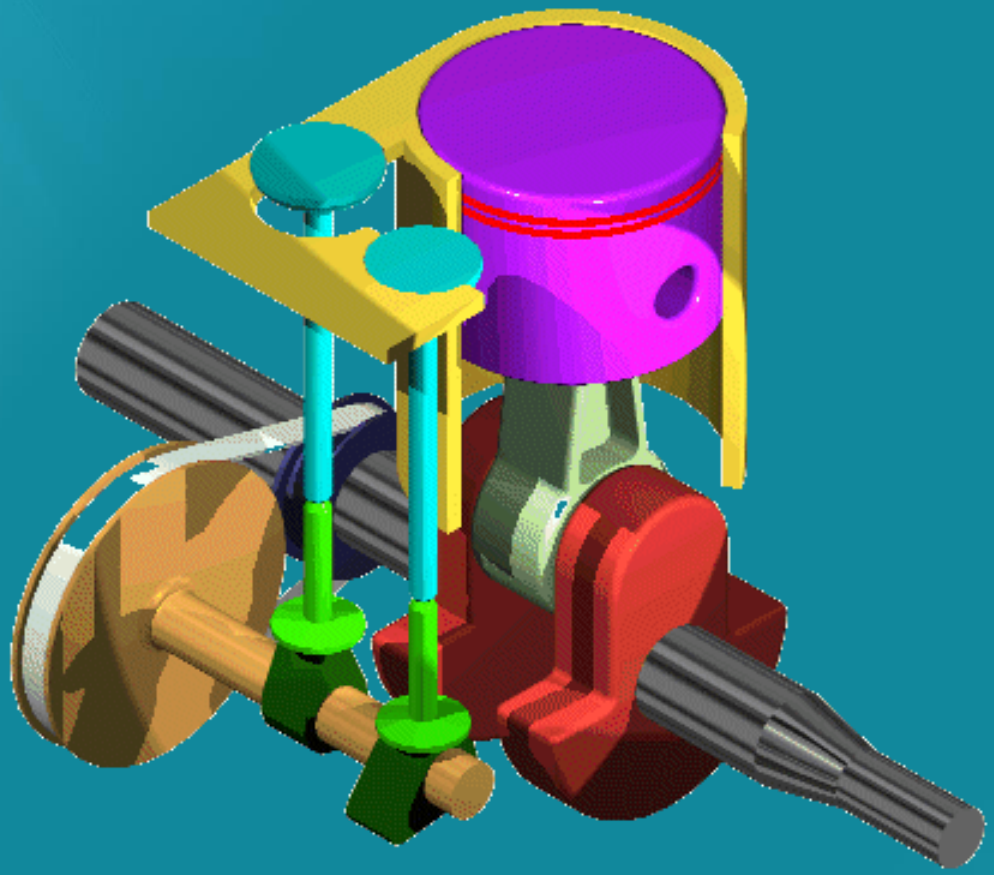


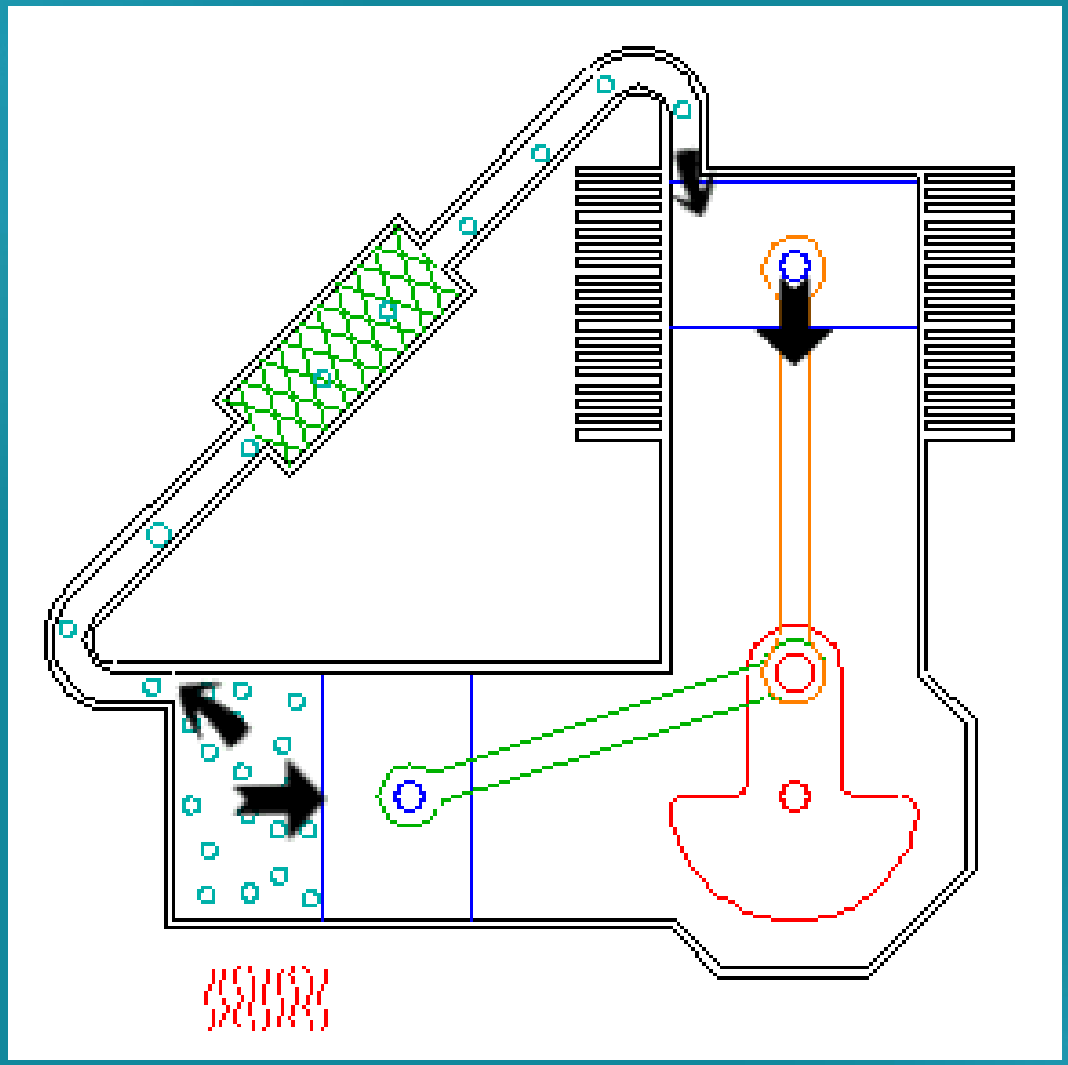
# Piezocylinder on the table:
## the example of 3-D positioning system


Connecting wires
Piezoceramic cylinder 6 x 5 x 6mm (D x d x h)
Ferromagnetic plate with
thin glass

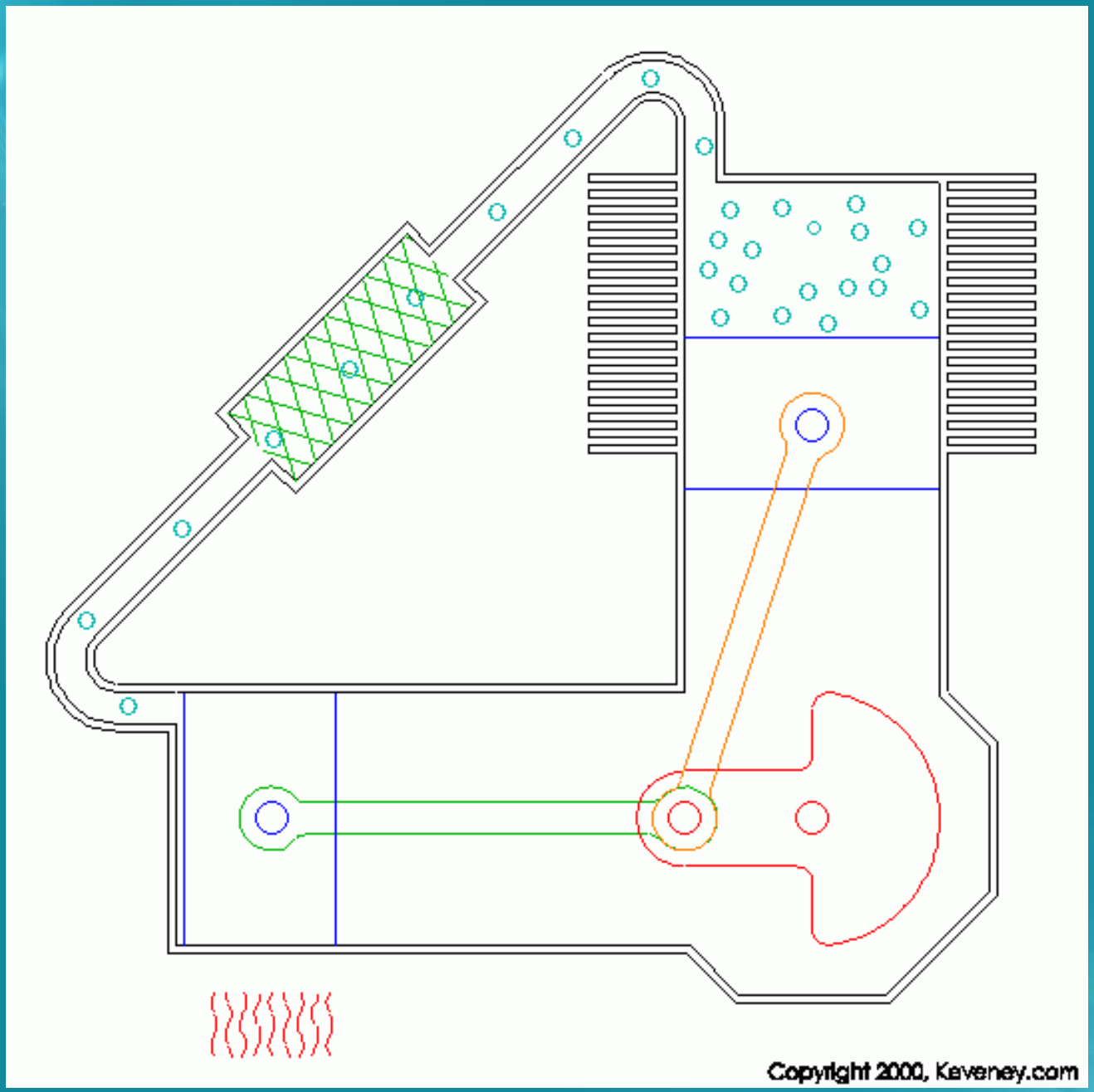
# ‘Smart’ LEGO figure

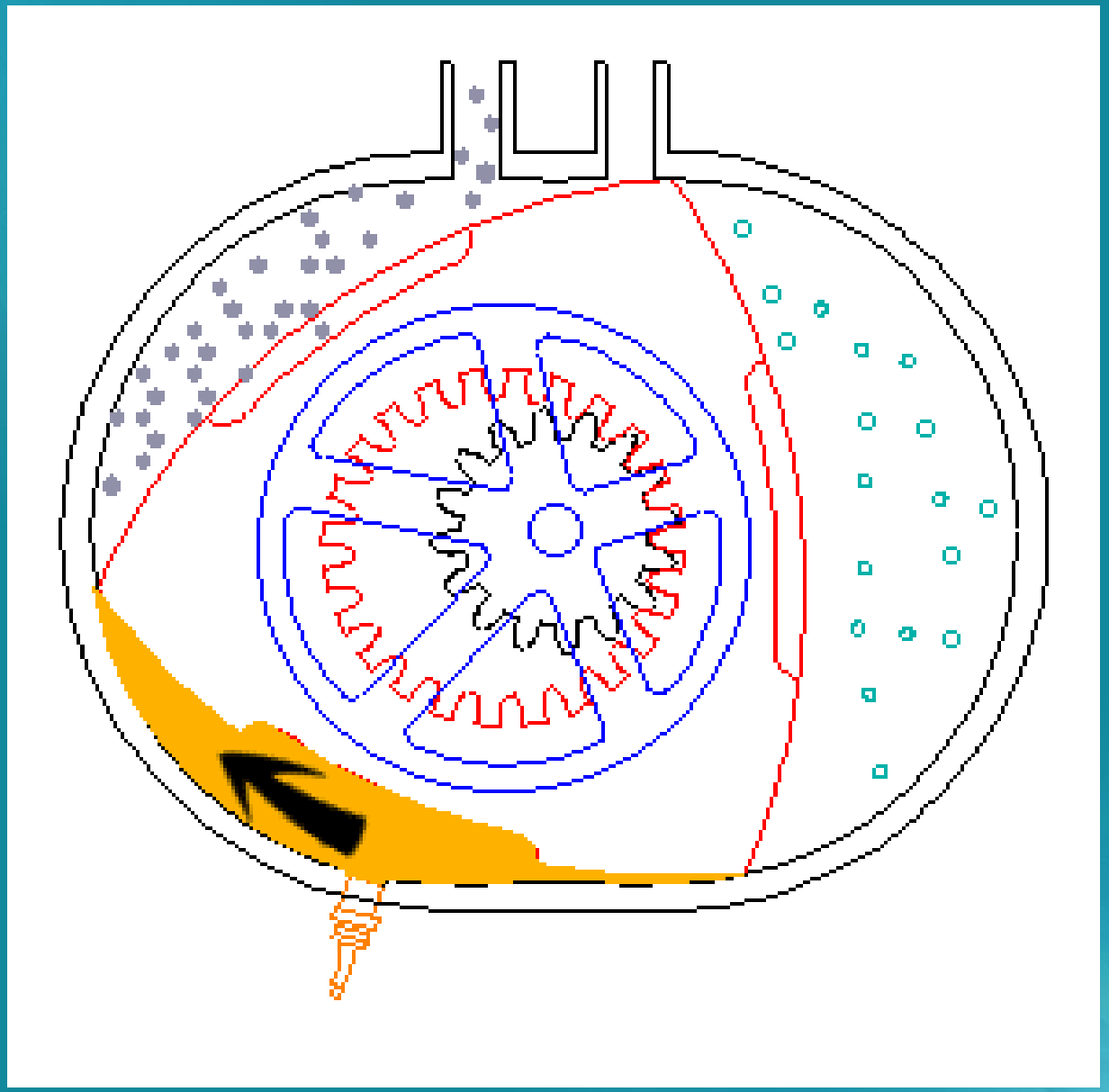




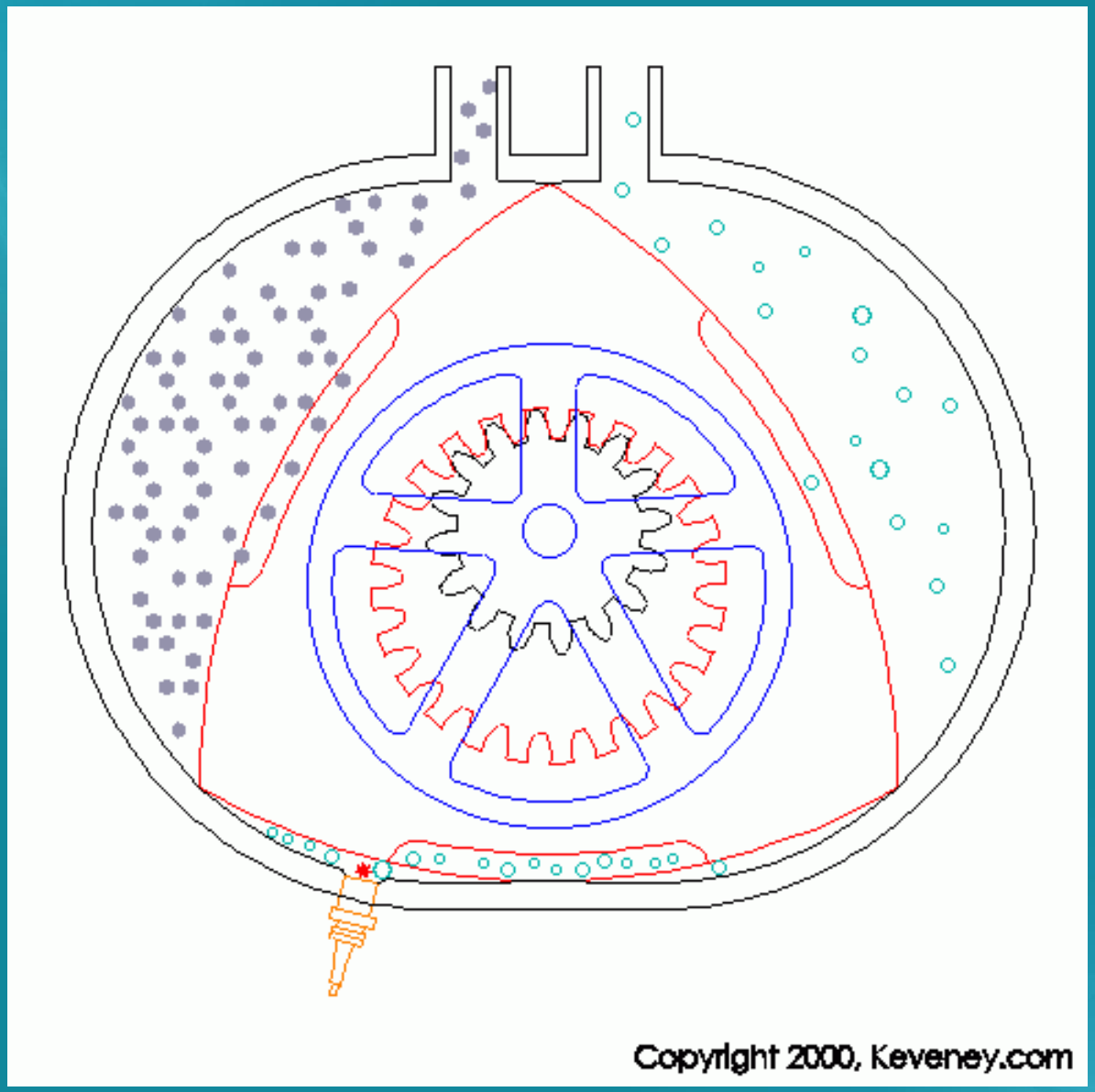


Stirling Engine


Copyright 2000, Keveney.com

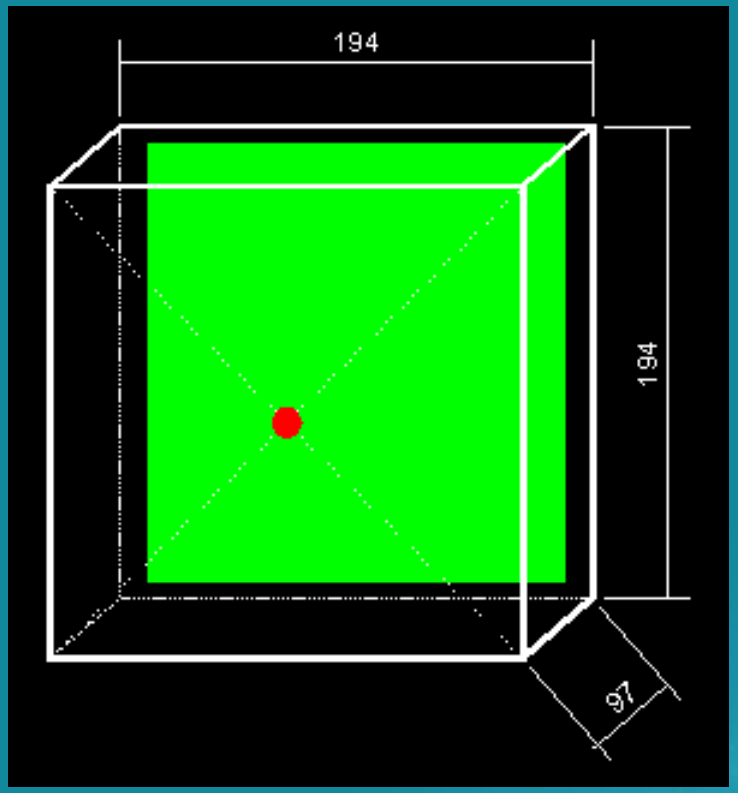


Wankel
Engine

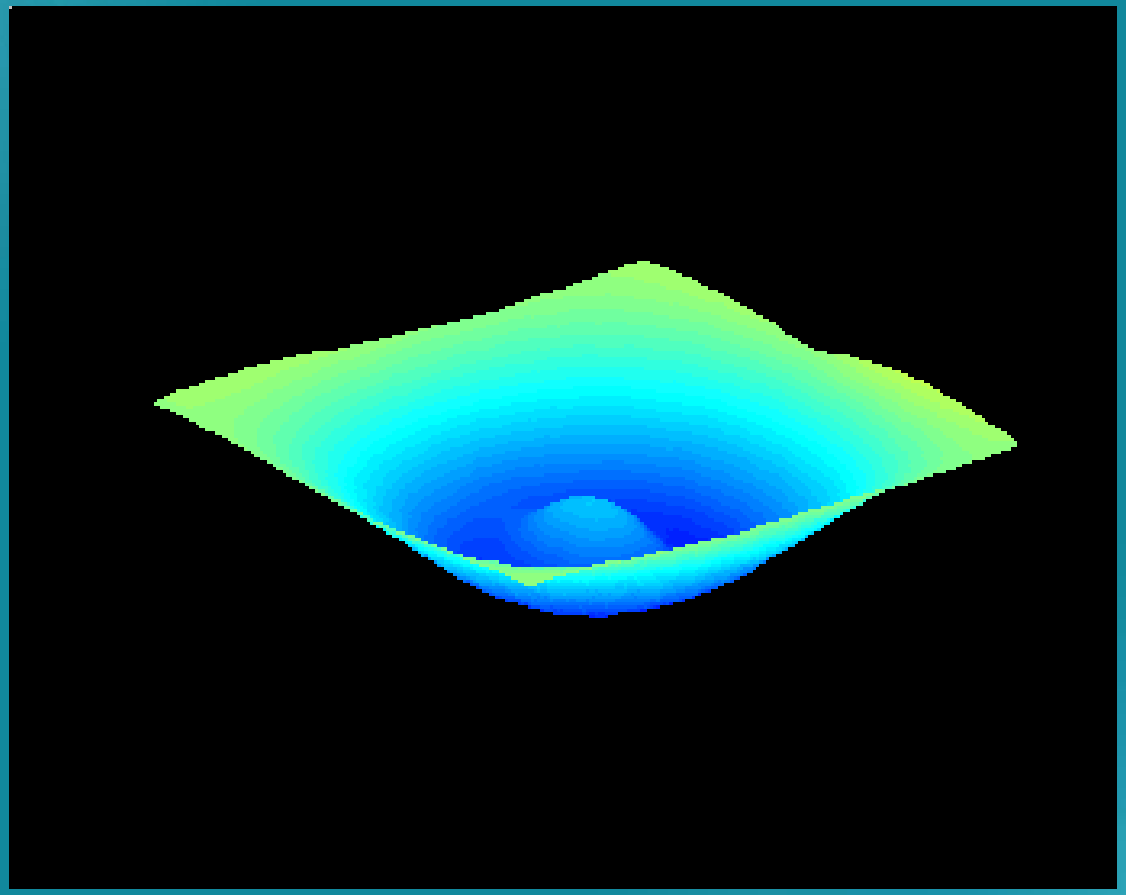

Copyright 2000, Keveney.com

# Complicated Problem of Elastic Waves Propagation:

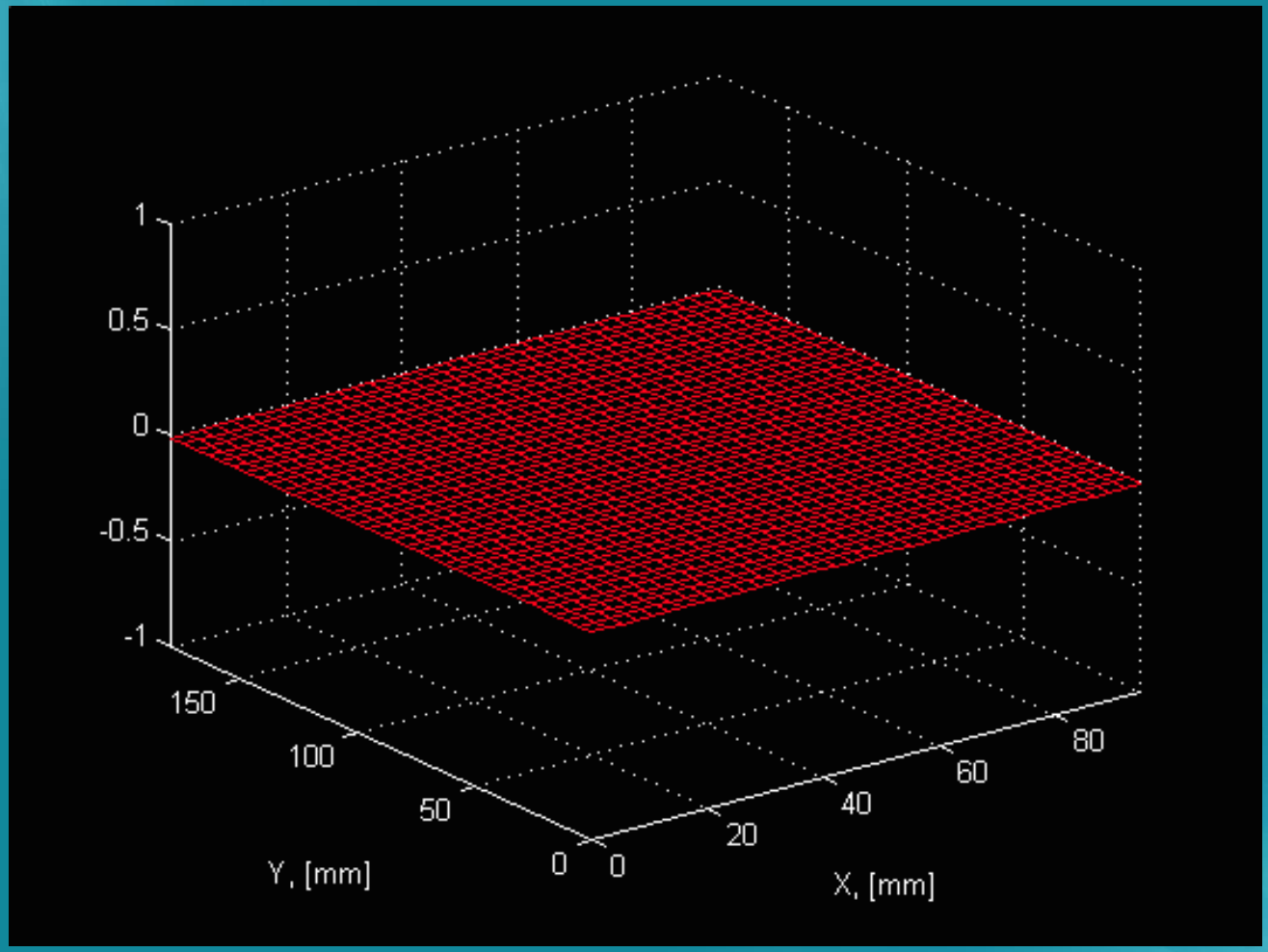
## How to make it simple


194
194
97

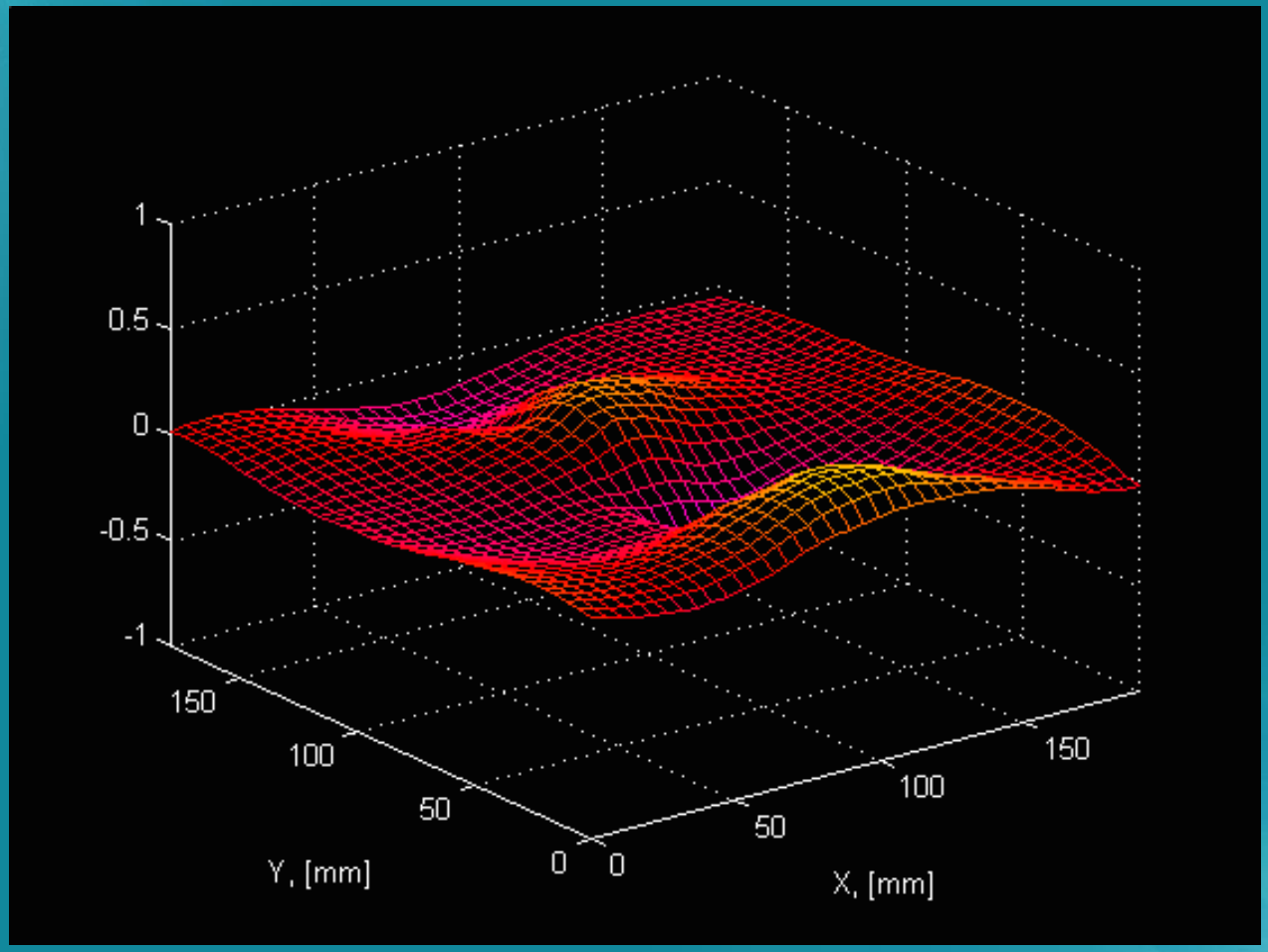
# Visualizing the oscillations after solitary impact



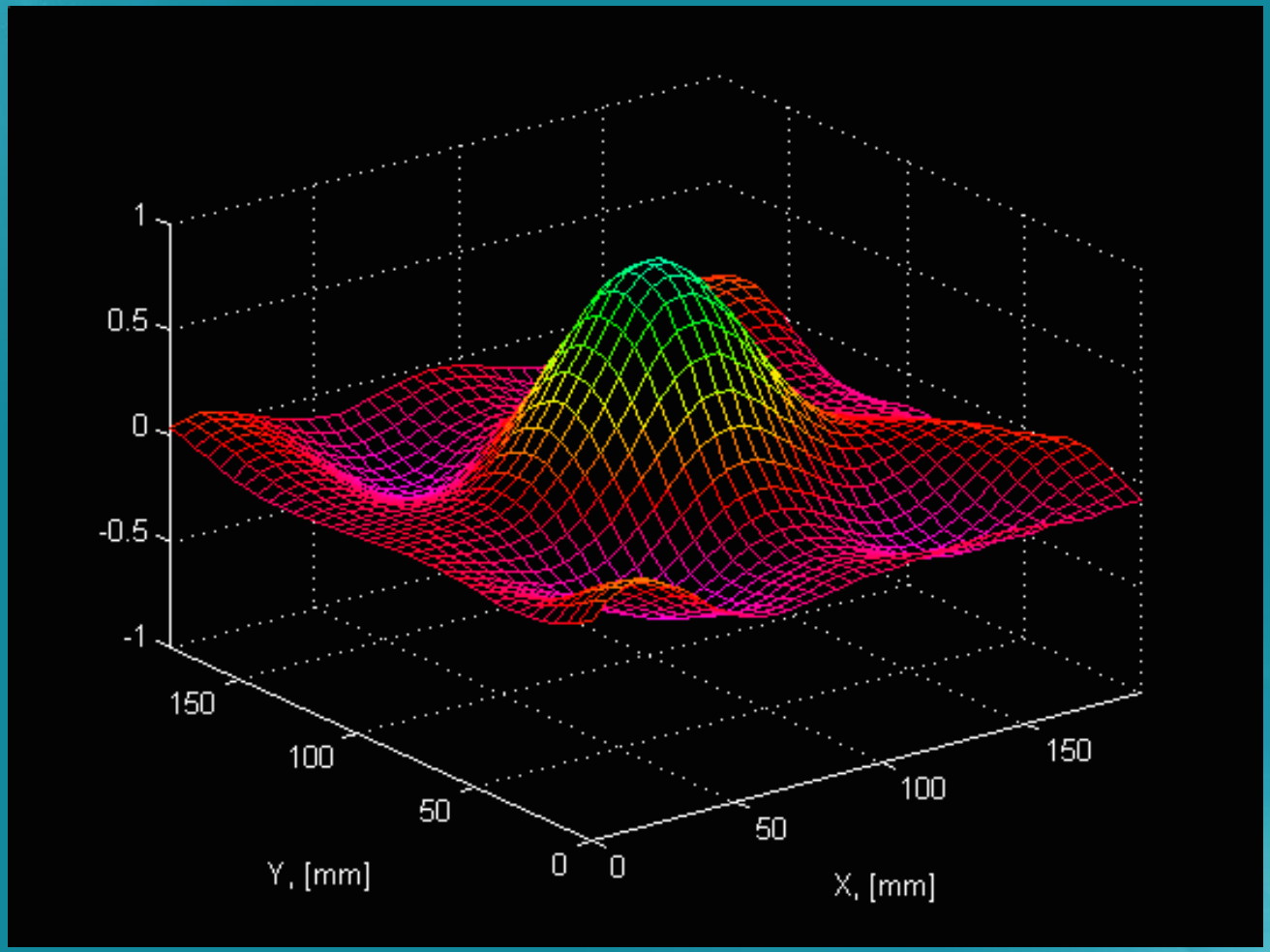
# All forms



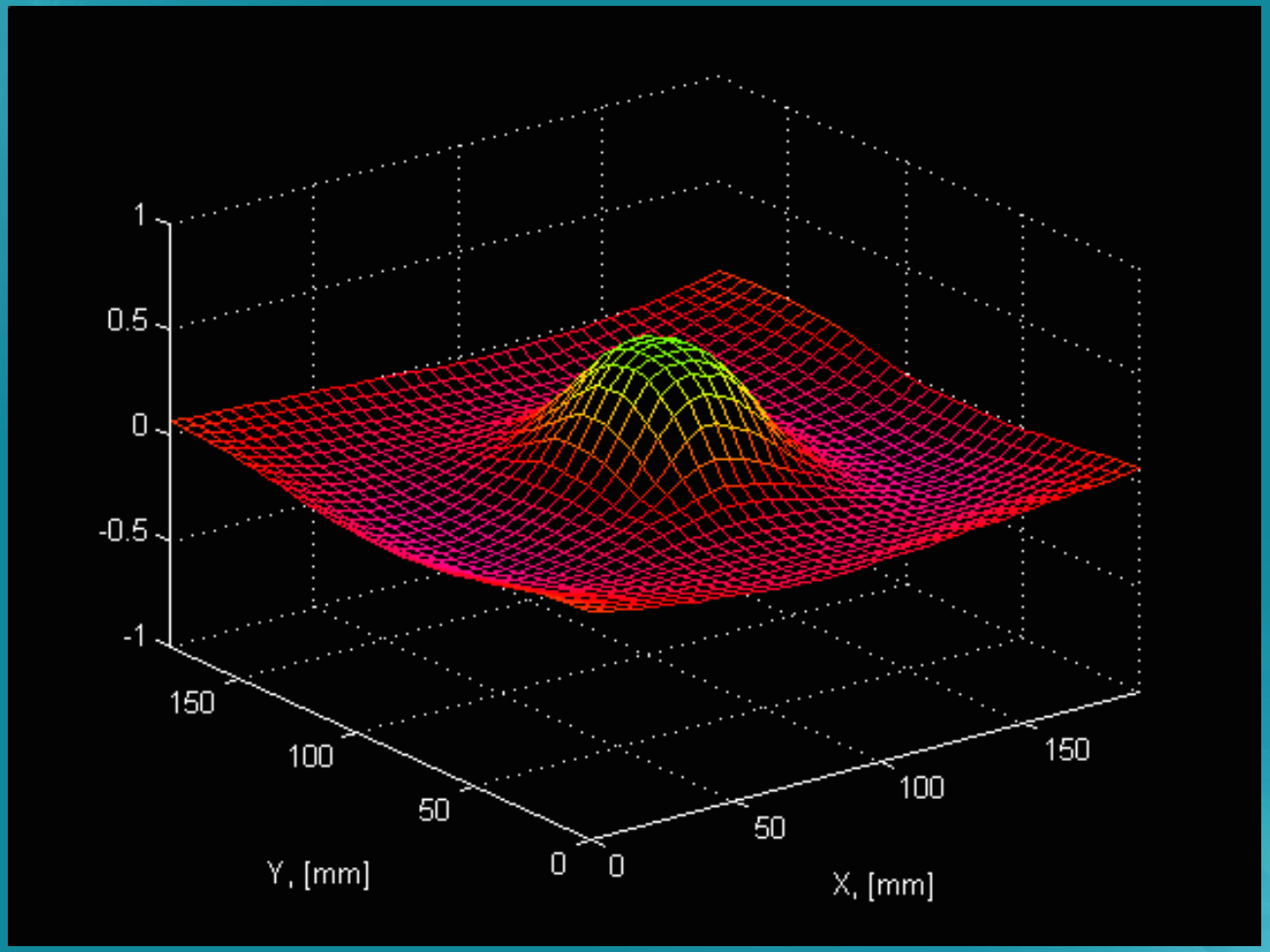
# Second form



# Third form



# Fifth form



# R&D activity and innovations

# Some examples

in KTU nearly 5000 students are graduating each year at Bachelor, Master or PhD level. Industry can suggest their problems for theses (www.ktu.lt/lt/ktu/inis/anketa.html);

- every year (beginning from 2002) the best innovative ideas and devices, created by students, are shown at TECHNORAMA. In 2004 there were 74 exhibits in Technology, Medicine, Sports, Management, Advertising, Marketing.

# ‘’Renaissance” in Innovation activity:

The example of Vibrotechnique Centre of KTU

- From 1965 to 1990 approx. 3000 USSR inventions have been registered;
- Nearly 300 PhD and Habil. Dr. theses have been presented;
- Some ideas are being copied even now: Piezoelectric motors, PiezoSkies, ERF, Array Manipulators, etc.

# Why it happened?

- The personality of scientific leader Prof. K.Ragulskis;
- High priority of Precision Mechanics (space and military applications - sufficient financing;
- To present PhD theses from 2 to 5 officially registered inventions were obligatory;
- The authors of the inventions were highly appreciated – prizes like EUREKA, medals in exhibitions, etc;
- The average age of staff and PhD students was less than 30; young people are more future-oriented and open to new experiences, with fewer preconceptions and assumptions;
- Dedication and commitment to projects were extremely strong;
- 50 roubles for every invention was paid to author (subjected to no taxes).

# Can it be repeated now?

In Market Economy:

- idea generation;
- evaluation (selecting the ideas);
- development (refining the idea for concept to working reality);
- implementation (making the idea happen for real).

## Up to now every professor is evaluated every 5 years according to:

- his activity in R&D;
- his activity in studies (to much more less extent);
- ISI papers;
- money brought to University from the contracts with local and foreign partners;
- EC Framework V and VI projects.

So why bother about innovations?

# The Role of Innovations in Evaluation of R&D results

(project developed by Lithuanian Science Council, November 22, 2004)

| Patents, issued by: | Points |
|---|---|
| EPO (European Patent Office) | 100 |
| USPTO (US Patent and Trademark Office) | 100 |
| JPO (Japan Patent Office) | 100 |
| | |
| Lithuanian Patent | 8 |
| Other countries | 8 |
| | |
| Papers in Master Journal List of ISI – Institute of Scientific Information | 30 |

# What do innovative people expect from the organization they work for?

Quote from ADAIR on Creativity and Innovation, ed. By N.Thomas, 2004

1. Recognition and appreciation. There is often a delay between an innovative idea and the results of that creative work.
2. The freedom to work outside normal department boundaries in areas of particular interest. Creative people are most effective if they are allowed to work in the areas which interest them the greatest.
3. Contact with colleagues outside of the team.
4. Encouragement to take risks. Management should encourage calculated risks while being aware of potential disasters.

There is a project at Government level to limit the possibility of a part-time employment of professors at some industrial company.

This act – if accepted - could finally destroy university/industry cooperation.

# University: checklist for creativity and innovation

- Are its professors capable of challenging the accepted?
- Do they see problems as opportunities?
- Do they fear ridicule when present a new idea?
- Are they able to look further than the immediate logical answer?
- Are creativity and innovation encouraged in teams as well as individuals?
- Is University committed to innovation from the top?
- Is University tolerant of failure?
- Are ideas generated from many different sources?

# Professors: checklist for creativity

- A willingness to accept risk;
- An ability to develop half-formed ideas;
- An ability to be flexible;
- An ability to respond quickly;
- A personal enthusiasm.

A well functioning patent office is key in an Innovation Economy. In the U.S., however, it's not working very well. Since 1997 the number of patent applications has risen by 50%, but the backlog of patents waiting for action by a patent examiner has quadrupled.

Business Week, Oct 11, 2004

# University and Society

- ‘’Kaunas as a learning city” – most successful project!

- KTU Business incubator – spring-board for young innovators;

- Science parks, Technopolis, etc.

- National Mechatronics Center, National Materials Centre, etc. – the basis for industry and academia cooperation;

- Projects related to the creation of Information Society, financed by EU structural funds (LIEMSIS, etc).

# Success story:

# Project THE PARTNERSHIP OF TECHNOLOGIES

Global experts net – 20 000 experts worldwide from:

-Berkeley & MIT, USA;

-Frauenhofer & Steinbeis, Germany;

-Danish Institute of Technology;

-TNO, Netherlands;

-KTH, Chalmers, IVT, Sweden;

-SINTEF & TI, Norway;

-VTT, Finland;

-Cranfield Imperial College & Dera, UK.

# CONCLUSION:

## Can your University be considered as Innovative?

1. Is the top management of the University committed to innovation?
2. Does the University express clearly its vision?
3. Is Rector openly enthusiastic for change?
4. Is the University good at team work including the use of project teams?
5. Are mistakes and failures accepted as part of risk-taking?
6. Do creative people join and stay with University?
7. Is innovation rewarded – financially or by promotion or both?

8. Are resources given to new ideas?
9. Is the structure of the University flexible?
10. Do all staff see themselves as part of the creative and processes?
11. Can ideas be exchanged informally and are opportunities provided to do this?
12. Does the University take a long-term view of the benefits of innovation?
13. Is innovation part of the organization's vision and strategy?
14. Is it fun to work in your University?

Adapted from: *Adair on Creativity and Innovation*, Ed. By N.Thomas, 2004

Thank you!