

« Slow technology » and others methods for Scientific Development

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International Union of Pure and Applied Physics

C13 Meeting ICTP Trieste

23/08/2008

What is « slow technology »?

➤ The basic concept is to find **high technology components** in different kind of mass produced appliances and to use these components for **other purposes**, in particular to build small scientific instruments

Importance in:

➤ basic education

➤ university

➤ and even

basic research (in the case of laboratories with limited funding)

➤ **Providing low cost high tech components for physics**

What is needed? : basic scientific and technological knowledge and a good dose of creativity!

Examples of Slow Technology

“Bad”
Slow
Tech.

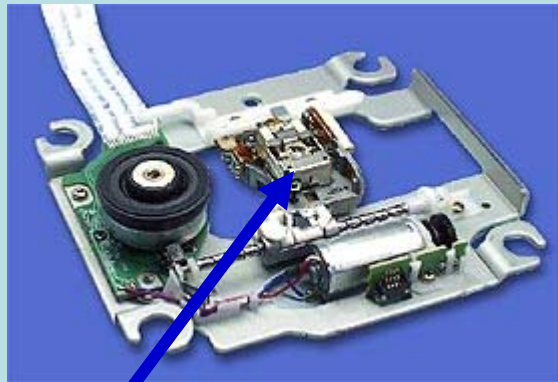


← “Popular” use of
CD as scarecrow

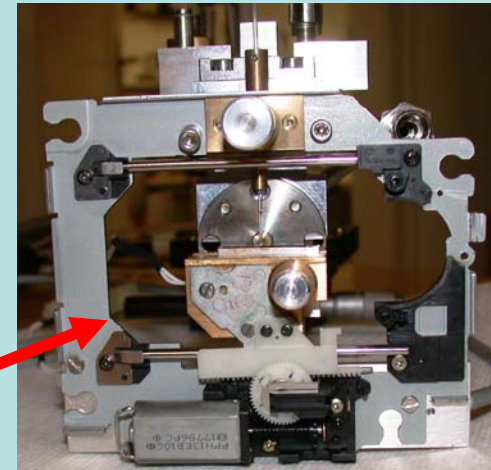
More “Creative” use of
CD (Peru) →



“Good”
Slow
Tech.



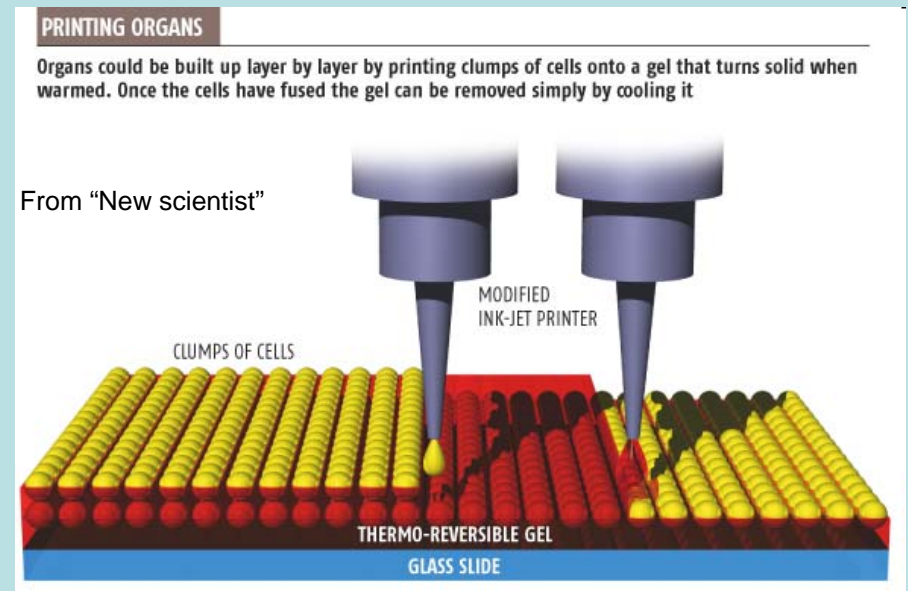
Slow tech used in basic
research: CD-ROM optical
pick up translation re-used
for sample translation under
vacuum in a cavity ringdown
experimental set-up



Courtesy: M. Arold from
Iena University (Germany)

It is a kind of re-engineering concept already used in high tech science development

- Example: ink jet printer technology is already used for other different purposes than the initial one : “drop on demand” systems provides low cost and contactless printing
- Mass spectrometry « Maldi » for analysis of biological systems
- Micro-electronics (photo resist printing)
- Creating biocompatible tissues



Why relying on instrumentation?

- Instruments are a way to give access to science in a « touchable » way.
- Starting from instrumentation and going back to science basic concepts
- Instruments are important for developing applied research
- There is a real need for miniaturized instrumentation to make measurements in the field and in remote areas.

“Despite the overwhelming importance of scientific research in the quest for the sustainable development of modern societies, universities and research institutions in developing countries continue to suffer from inadequate scientific equipment.

The scientific workforce cannot be trained and research cannot be conducted at a level comparable to that of other similar institutions worldwide if the essential instruments, equipment, and facilities are unavailable or are not maintained.

This situation must be acknowledged as one of the major reasons research output from certain countries is only a fraction of global scientific productivity.”

Cecilia B. Öman International Foundation for Science (Sweden)

Karniyus Shingu Gamaniel University of Maiduguri (Nigeria)

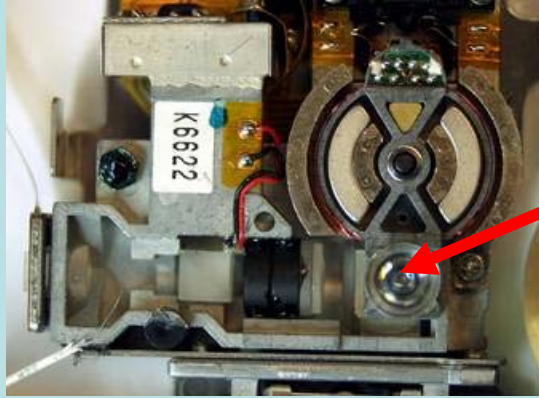
Marian E. Addy University of Ghana

Analytical Chemistry 78 (15), 2006, 5273

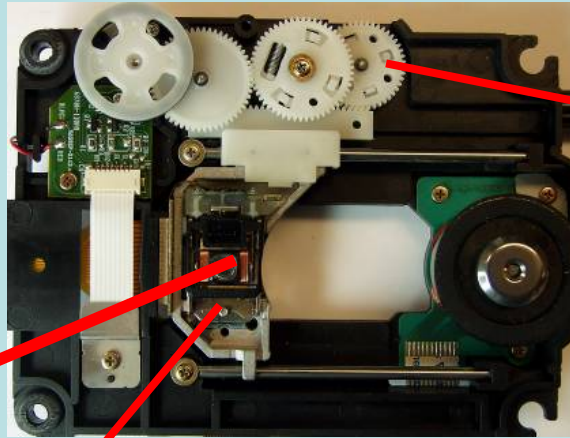
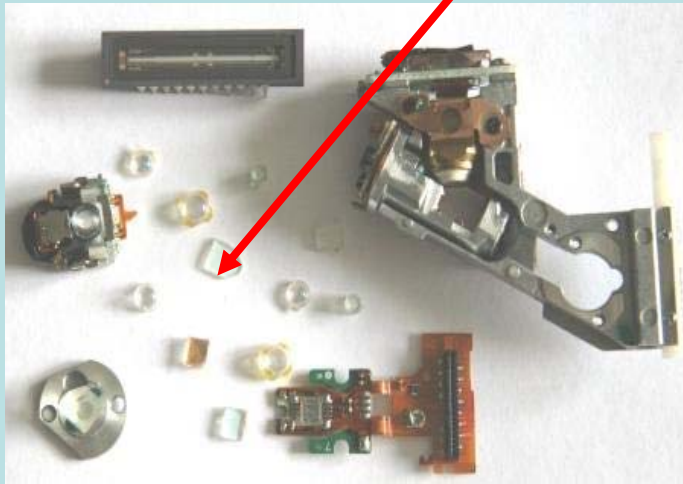
Where to find high tech components?

- Computers
 - Laser Printers
 - CD-ROM drive
 - Scanner
 - Mouse: <http://www.hackaday.com/2008/05/16/how-to-scavenge-a-mouse-for-parts/>
 - Camera
 - Mobile phones
 - Video projectors
 - Cars (modern one's)
 - Etc...
 - Some examples will be illustrated in the following
-
- Important for chemistry and environment there is the presence of rare elements in some of the components.

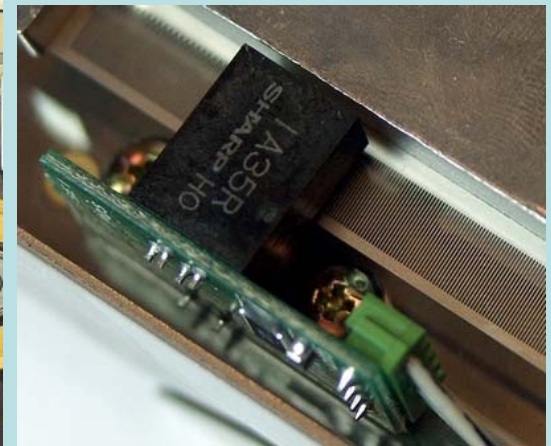
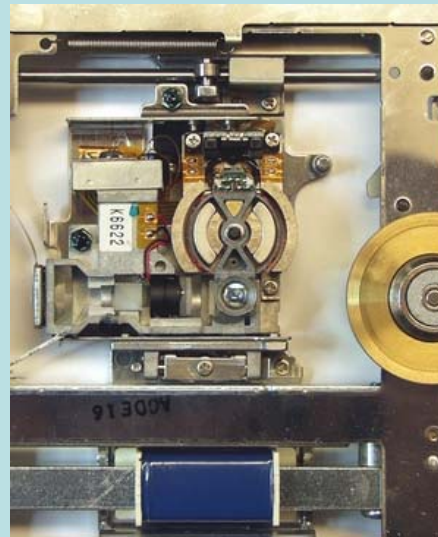
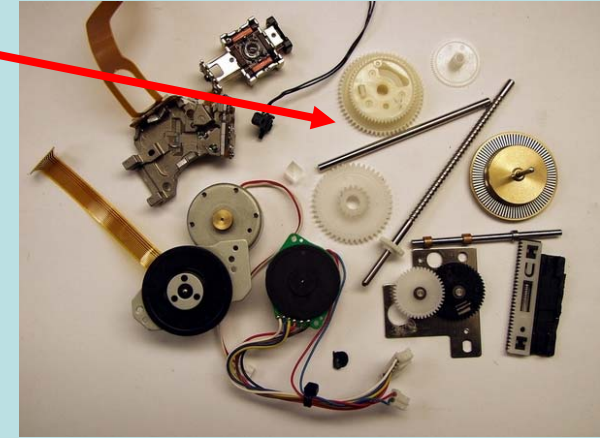
Example 1: CD ROM Drive



Optical parts



gears



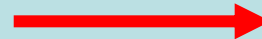
Position sensor

Example 2: Hard Drive



Applications:

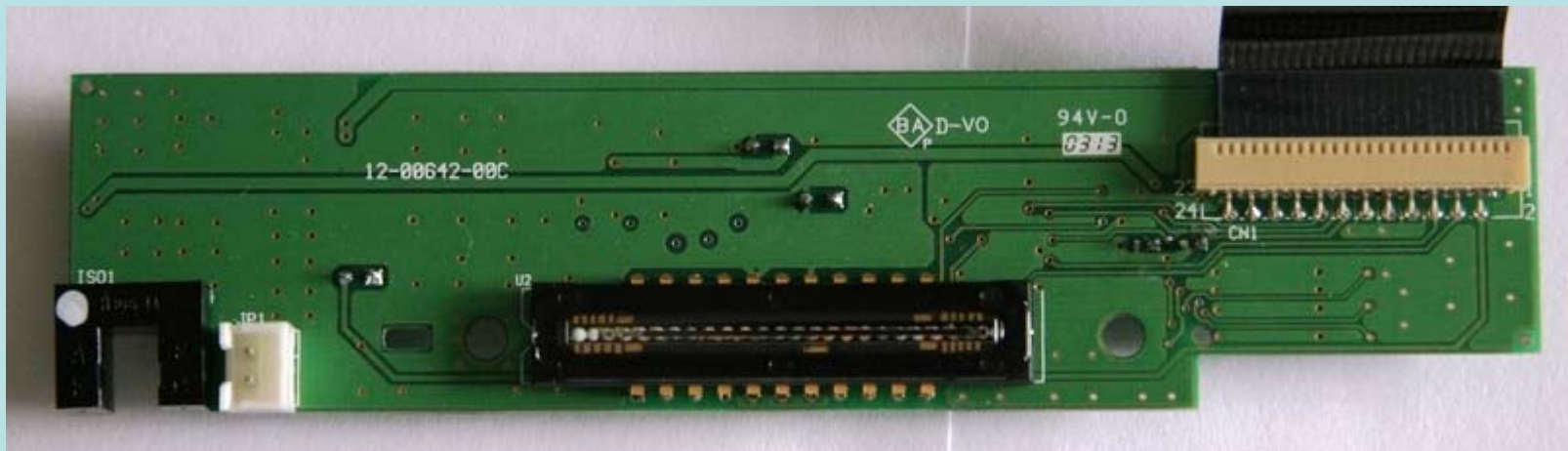
- Polishing
- Grinding
- Spin coating



Source: http://metku.net/index.html?path=mods/hdd_grinder/index_eng2

Example 3: scanner

- CCD (linear) detector



Camera's could provide 2D CCD detectors

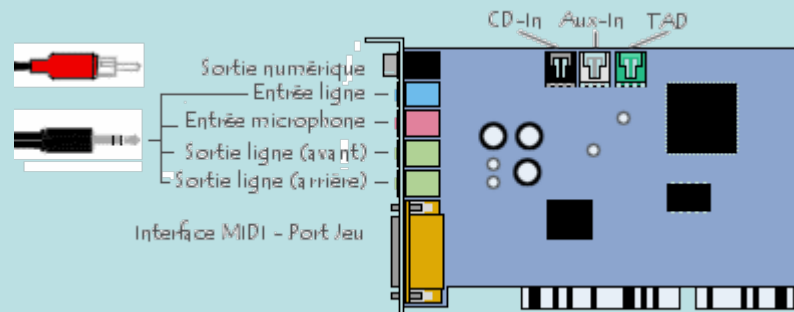
From laser printers



For a complete description of what could be found in a laser printer please go to : <http://www.evilmadscientist.com/article.php/laserjet>

Example 4: sound board (audio board)

- Provides low cost ADC for digitizing analog signal



From slow technology to poetry!!!



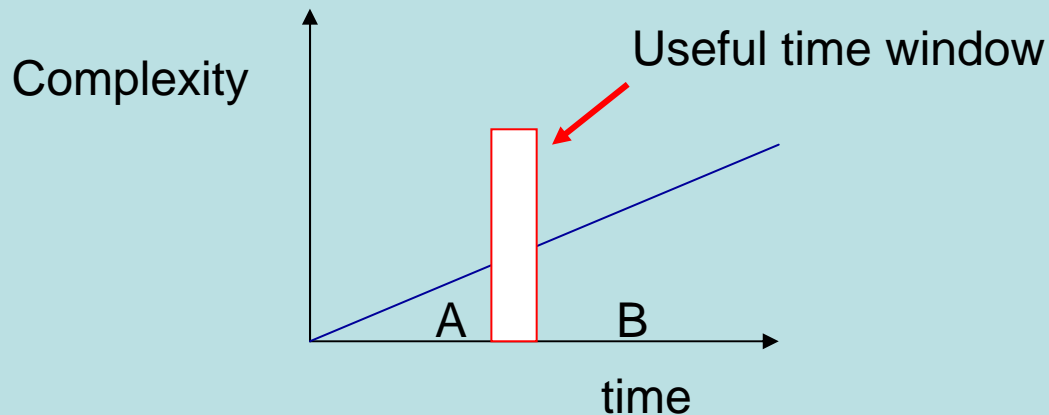
Underneath a
floppy disc drive!

Advantages

- Low cost: A high number of interesting appliances are fully widespread even in remote areas, as computers, mobile phones (**to be explored!**), etc.....
- Understanding of basic physics which is involved (how it works - opening the black box?):
- Increase of science and technology culture : **Technology ↔ Science**
- **Develop creative skills: find other purposes or applications and also get attached to simplicity and avoiding to discover things already available**
- Contribution to sustainable development :
 - 1 - Based on sorting out components from used appliances
 - 2 - Development of small scientific instruments fully adapted to the country
- **Ultimate goal: Development of small companies which may employ people which technical and scientific skills?**

Problems

- There is always a «time window » for using « old » technology (race against time)



A: appliances are no more found

B: miniaturization induces an increased complexity, access to “simple” component is no more possible

- Dismantling instruments and using their « second hand » components is **not very appealing** for many scientists and students especially in universities.
- Using some functions of the components is not easy if the original company is not willing to provide the information. (ex. Samsung).

Solutions?

- Tentative solutions to these problems:
 - Create a network of « senior » (respected!) scientists:
 - Will assess the respectability and the importance of “slow tech”
- Use of new “low cost” components (not free!):
 - As an example, LED's are now able to provide low cost light for spectroscopy and could lead to smaller portable field instruments if other components as detectors could also be miniaturized.

Favor “adapted” and “usefull” performances to ultimate performances

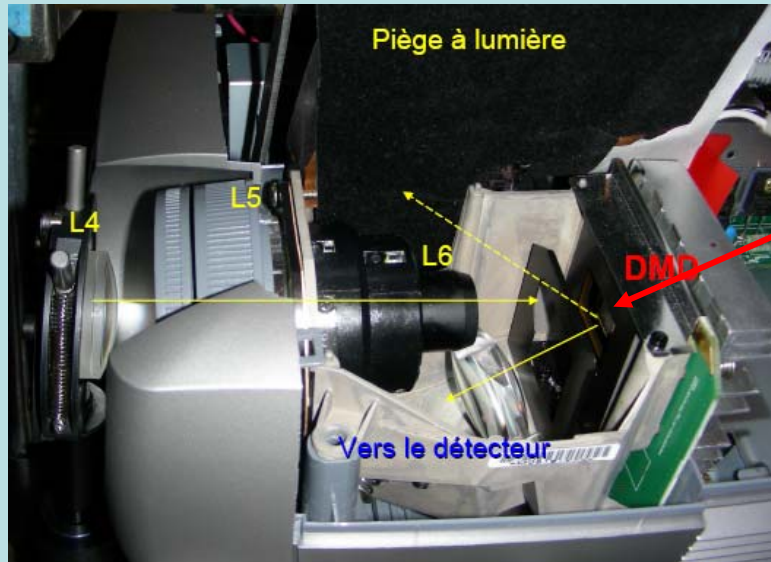
Different approach: Low cost STM for nanotech teaching at school Example of Münster University using new components

School Children Project: „Build your own STM“

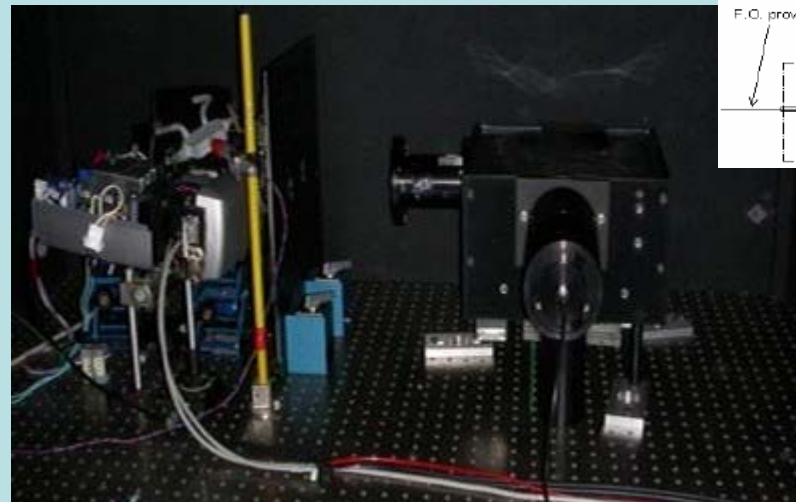
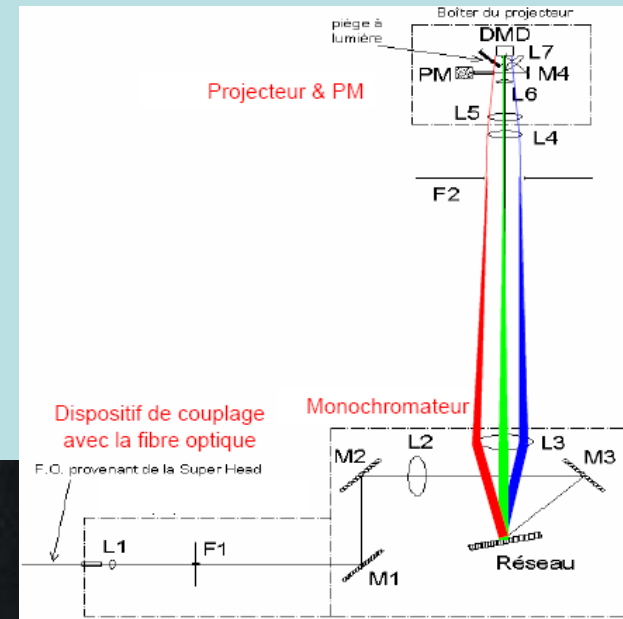


- the SXM-project allows competent school students to build a working Scanning Tunneling Microscope with total costs of 800 €
- students gain deep insight into scientific work and learn a lot about nanotechnology
- all needed information, sketches, control software and hints can be found on the homepage of the SXM-project of the University of Münster

2) Raman Spectrometer from a videoprojecteur



Use of the Digital Micro mirror Device DMD



Jouan

Da Siva

Nguyen Dao

Ecole Centrale de
Paris

Patent: Jobin Yvon

Spatial Light modulator from mobile phone LCD display



1 LCD display of a mobile phone converted to a SLM.

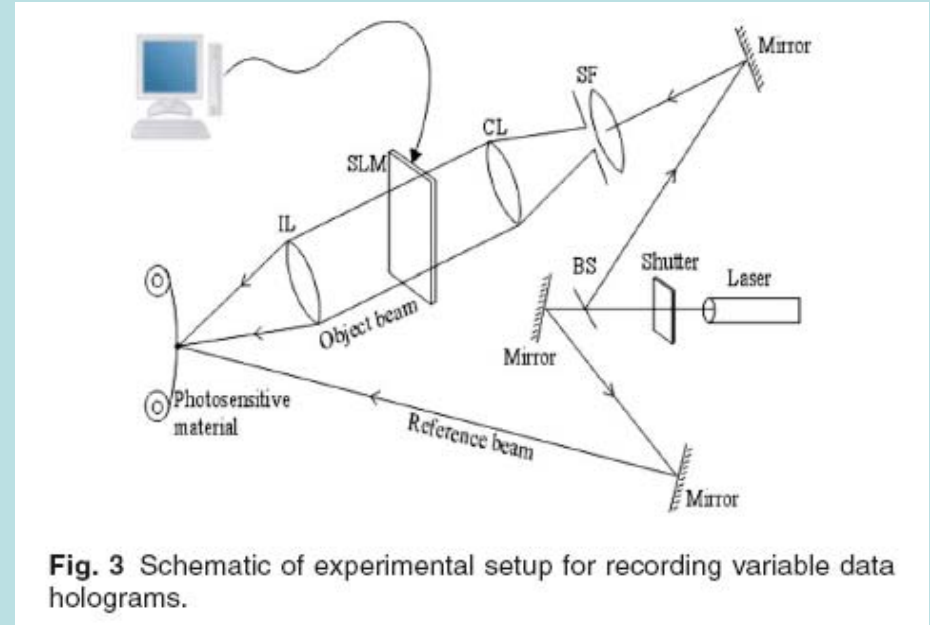


Fig. 3 Schematic of experimental setup for recording variable data holograms.

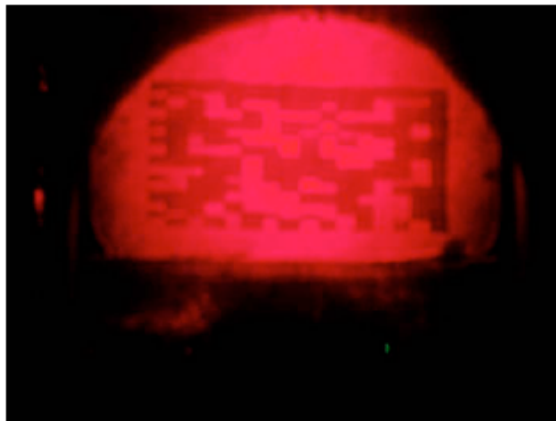


Fig. 5 Modulated laser beam.

Diapason

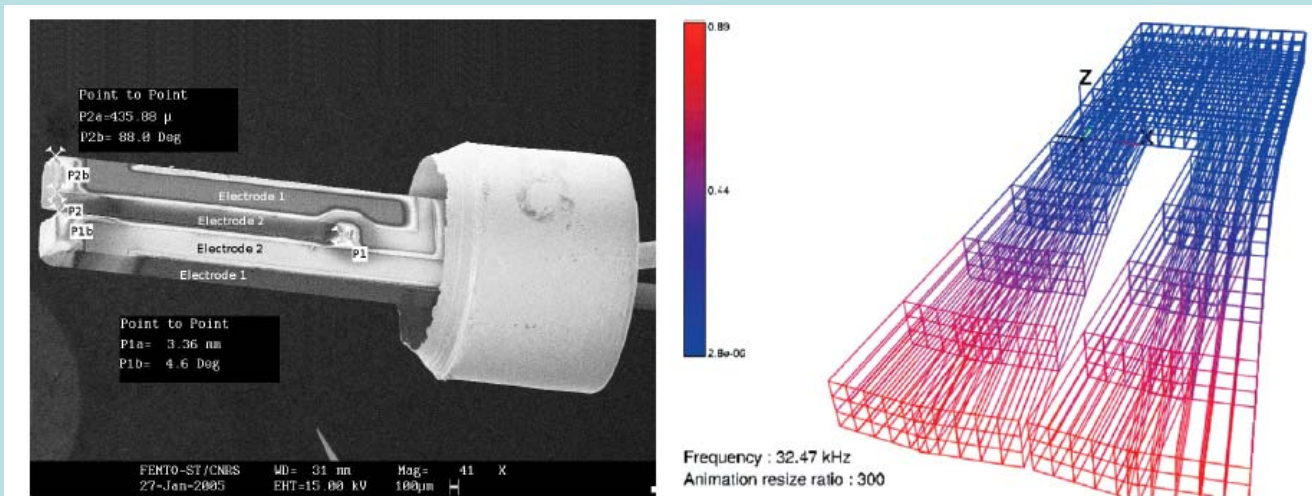
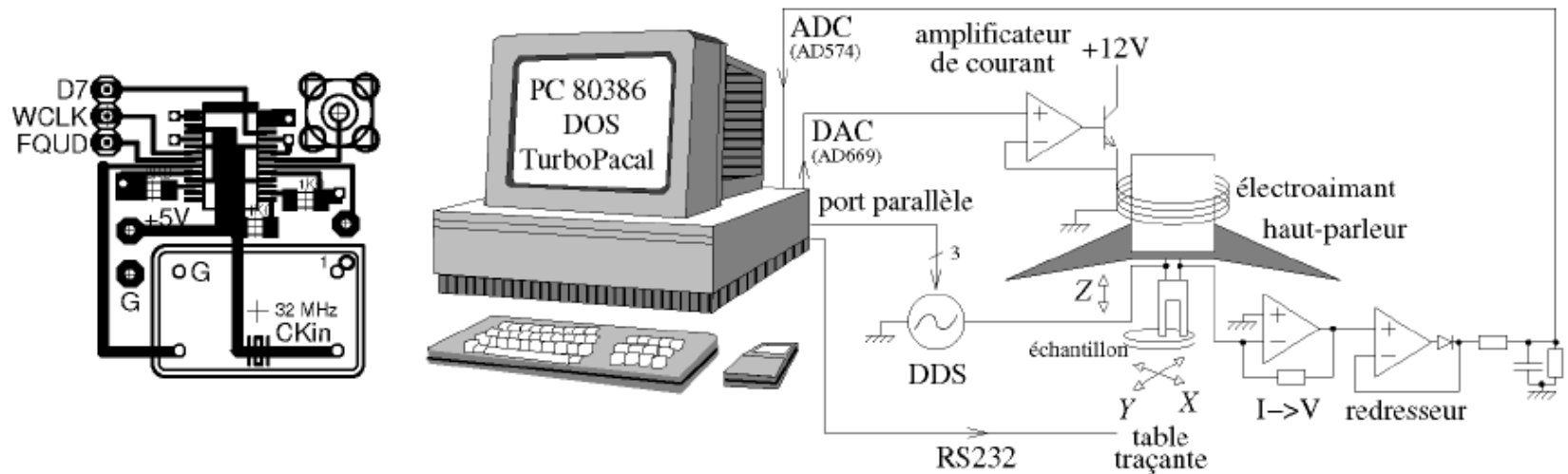


Figure 1 : *Gauche* : image au microscope électronique à balayage d'un diapason mettant en relief les électrodes. *Droite* : modélisation du déplacement à la résonance d'un diapason de $Q = 10000$ sous une tension de 0,5 V (logiciel de simulation développé par l'équipe de S. BALLANDRAS, LPMO - Besançon).



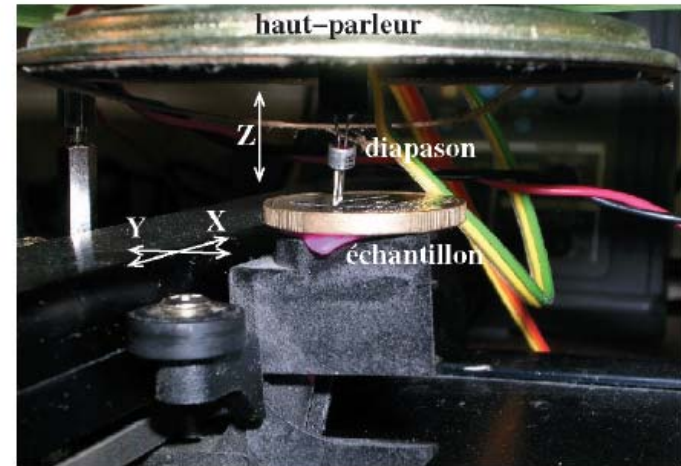
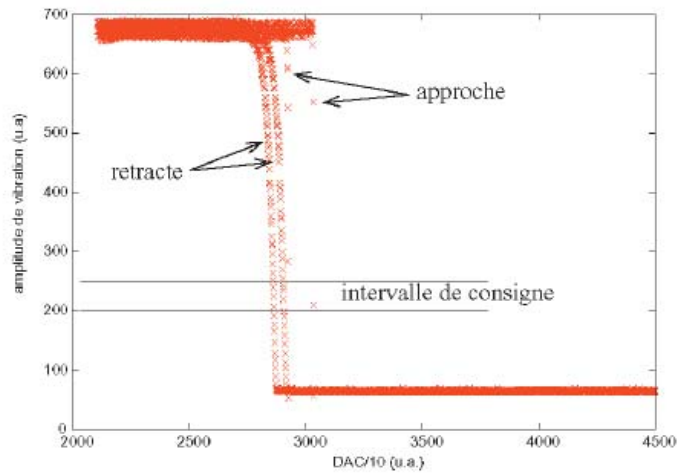


Figure 4 : *Gauche* : relation signal distance diapason-surface. *Droite* : photo du montage expérimental. Noter que seul le coin du diapason est en contact avec l'échantillon pour une meilleure résolution spatiale.

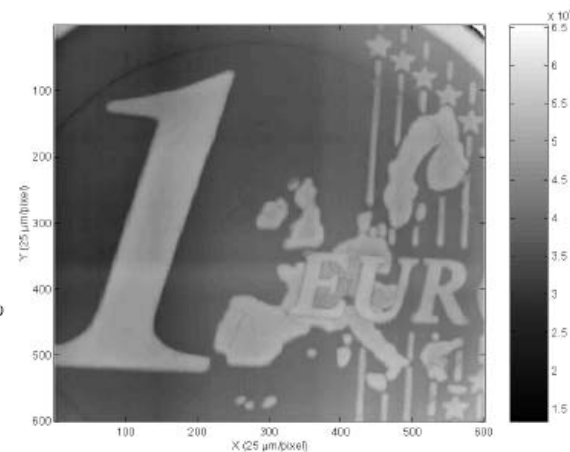
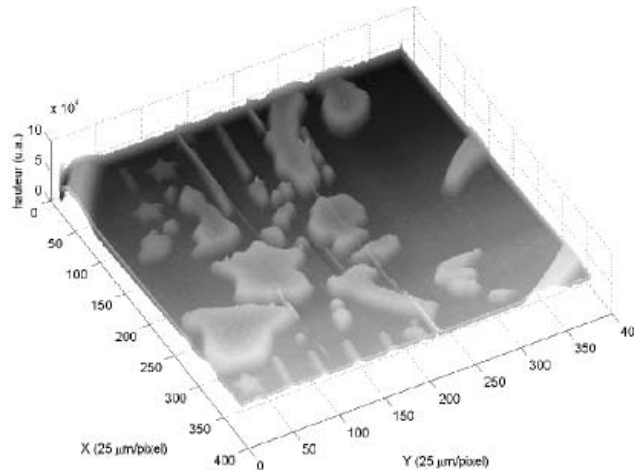


Figure 5 : *Gauche* : topographie d'une pièce de vingt centimes d'euro. *Droite* : topographie d'une pièce d'un euro.

Going further

- Building a strategy for information exchange and sharing
- What level ? International journals? Is as example « Review of scientific instrument » a good tool for that? Or a dedicated Internet web site could be better, → ICTP?
- Network of European scientists interested in this activity:
 - Tentative members:
 - Marc Antoine Dubois
 - René Farcy
 - Sune Svanberg (to be contacted) or
 - Ludger Woeste
 - Ismael Moya
 - Nguyen Dao
- Training and support may be provided by scientist about to retire or already retired willing to still contribute to development of science.
- Achieving a critical mass of scientists !!

Software and pharmaceutical examples

- « open » or « free » software enabled **low cost access** to different type of computing programs
- For pharmaceuticals, the emergence of Generic Medicine enabled emerging and third world countries to access to many medicines
- These two examples have paved the way for the emergence of « generic » scientific instrumentation which in part could be based on “slow tech”.
- **There is a need for working structures and strategies**

- Easiest strategy → Relying on Chinese industry?
- Even MIT has this kind of reflexion :
- → [International Development Design Summit \(IDDS\)](#) One complete month workshop at MIT for developing simple devices!!!
- <http://www.iddsummit.org/>
- <http://www.iddsummit.blogspot.com/>

Conclusion

- “Slow technology” is by no means an ultimate solution to the instrumentation problem of developing countries (it could evidently not be used for building very huge instrumentation such as mass spectrometers), but it constitutes a valuable help in many domains
- It also constitutes a very good opportunity to train people on science and technology at a reasonable cost,
- ❖ Applicable to every country from primary school to university
- ❖ It triggers creativity
- ❖ May result in instruments adapted to the rough climate of some countries
- ✓ But: there is a need of structure, strategy, communication!!!

This kind of concept is not new!!!

L'application d'une science à une autre est à la fois un moyen heuristique et un instrument de réorganisation de la connaissance.

d'Alembert, (Traité de Dynamique (1743))

Web sites where information may be found

- <http://www.hackaday.com> (forum)
- <http://www.evilmadscientist.com> (forum)
- <http://spritesmods.com> (forum)
- <http://www.kalanda.com/> (individual-spanish)
- <http://www.cs.cmu.edu/~zhuxj/astro/html/spectrometer.html>
- <http://felesmagus.com/pages/lasers-howto.html>
- <http://inventgeek.com/Projects/alpharad/overview.aspx> (alpha radiation vizualizer)

DIY lab scanner made from standard CD drive

12:44 25 September 2007

[NewScientist.com news service](#)

[Tom Simonite](#)

Fixing two additional light sensors to a normal CD or DVD drive can transform it into a highly accurate scanner for chemical or medical tests, Spanish researchers have shown. The team has developed a modified CD drive that detected tiny quantities of pesticide in samples placed on top of an ordinary compact disk.

Biologists and chemists often detect and measure compounds of interest, such as disease pathogens in blood or pollutants in water, by triggering interactions between these compounds and known proteins and antibodies. These immunoassay tests produce further compounds that can then be measured accurately, typically using light.

However, the machines used for light detection are expensive, normally costing between 30,000 and 60,000 euros, says Angel Maquieira, of the Polytechnic University of Valencia, Spain.

Maquieira and colleagues found that an off-the-shelf CD drive can be modified to do the same job. While a laboratory machine has to precisely scan samples with light and record the results,

 PRINT  SEND  RSS FEEDS  SYNDICATE



[Enlarge image](#)

A couple of extra light sensors turn an everyday CD drive into a cheap, portable, chemical scanner that could replace larger, more expensive machines (Image: UPV)

Patrick Corran, who uses immunoassays at the London School of Hygiene and Tropical Medicine, says modified CD drives could be perfect for use in poorer countries. "I study malaria and I'm always aware of the importance of making equipment available to developing countries," he told *New Scientist*. "A cheap and cheerful device made from mass produced and easily available products could help with that."

Corran adds that future disk drives may be even more useful, since next-generation systems like [Blu-ray](#) and [HD-DVD](#) use shorter wavelength lasers that are closer to those found inside laboratory machines.