AFM-kit

Development of a kit for building from scratch an educational *(but decently performing - i.e. usable)* AFM.
Building AFM is the best way to understand how it "really" works.

**Initial tasks**

- Define minimum performance of the instrument

- Consider different aspects: mechanical support, actuators, detection electronics, feedback and software.

**Inputs from other activities**

**Practical notes.**

**Virtual tools**
An example of low cost AFM: FLEX afm

- The Nanosurf® EasyScan 2 FlexAFM
- Liquid ready AFM for the life sciences
SPM-M Kit from Mad City Lab

- XY movement of sample, 200μm
- Z movement of probe, 30μm
- Akiyama probes

MadPLL® controller is a digital phase lock loop (PLL) controller + software for resonant probe (Akiyama probe or tuning fork)

AFM constructed from the SPM-M Kit
Breadboards, manual XY, and manual Z positioners not included
AFM kit from AFMWorkshop

AFMWorkshop
http://www.afmworkshop.com/

Atomic Force Microscope Kit
With this kit it is possible to construct a high powered atomic force microscope. Included with the kit are all of the parts for constructing the TT-AFM, a computer, monitor, probes and a reference standard. ($25,950.00)
MIT 20309 Atomic Force Microscope

force detection $\rightarrow$ interdigital interferometer

scanner $\rightarrow$ buzzer

Workshop Education Camogli, Italy, 15-16 April 2013
AFM Subsystems

- **HEAD** Head mechanics, piezo actuators, probe holder, sample holder, force detection optics.

- **ANALOG ELECTRONICS** quadrant detector, laser supply, signals for tapping

- **DIGITAL ELECTRONICS** AD/DA, data acquisition, feedback

- **CONTROL SOFTWARE**

- **IMAGE PROCESSING SOFTWARE**
Mechanical Head Concept Design Example

- XY scanner (sample)
- Z scanner (probe)
- XY Z scanner (probe)

Lorenzo Barni  Phd Tesis Mechanical Engineering University of Florence 2009

Workshop Education Camogli, Italy, 15-16 April 2013
Print your atomic force microscope

Laser driven rapid prototyping design of the printed pieces was done in Solidworks software

Ferdinand Kühner, a Robert A. Lugmaier, Steffen Mihatsch, and Hermann E. Gaub
REVIEW OF SCIENTIFIC INSTRUMENTS 78, 075105 2007
Force detection method

- Optical Beam Deflection
- Interferometer
- CD or DVD pick-up
Probe Holder

- easy alignment in air and liquid
- use standard probes
- easy to clean
Control HW - Software

GXSM Gnome X Scanning Microscopy

*DSP-based system (4200 $Can)*

**REAL TIME**

*real time pc + AD/DA board*


Michele Basso, Roberto Bucher, Marco Romagnoli and Massimo Vassalli “Real-Time Control with Linux: A Web Services Approach”

Realized using SIMULINK™ visual programming language, the real-time code is automatically generated by MATLAB REAL-TIME WORKSHOP™.

RT process directly inside the kernel space

DAQ board PCI-6221 National Instrument

LINUX RTAI

Workshop Education Camogli, Italy, 15-16 April 2013
RTAI, Scicoslab and RTAI-XML
Image processing software

**WSxM** v4.0 Beta 6.3
http://www.nanotec.es/

**Gwyddion** http://gwyddion.net
is Free and Open Source software

Petr Klapetek
Czech Metrology Institute, Brno
Czech Republic

David Nečas (Yeti)
Plasma Technologies
CEITEC – Central European Institute of Technology
Masaryk University, Brno
Czech Republic

Workshop Education Camogli, Italy, 15-16 April 2013
AFM in Florence
AFM KIT: REQUIREMENTS

- Operating modes: contact tapping
- Force spectroscopy
- Optical access: capable to operate on an inverted optical microscope (Daniel Navajas)
- Spring constant calibration
- Operate in liquid

Workshop Education Camogli, Italy, 15-16 April 2013
Useful links.

**MIT OPEN COURSE**

**SPM OPEN SOURCE CONTROLLER**

**MAD CITY LAB**
http://www.madcitylabs.com/spmmkit.html?gclid=CIWE6KTIkLYCFePHtAodJTUADA

**FIRST-Sensor 4Q detector**

**STM project and Disk Scanner**
http://www.geocities.com/spm_stm/index.html

**AFM workshop**
http://www.afmworkshop.com/