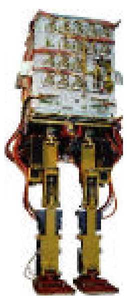
specified and dealt with. At the same time the formalism used to describe the system of interest should be synthetic, easy to implement and general enough to encompass a wide class of problems. Under these conditions, it was decided that the most effective analytical framework was that of **complementarity systems** . The decision for this framework was reached unanimously by all the participating teams.

· **Ability to characterise existence and stability of solutions**. In particular, methods are required to investigate the existence of different types of solutions (e.g. periodic solutions) and assess their stability. This is particularly relevant to solve parametric continuation problems for nonsmooth systems.

· **Fast computational engine for time-integration and parametric continuation**. Numerical algorithms need to be derived in order to perform an *accurate* time integration of complementarity systems incorporating their main features (LCP or NCP solvers, treatment of finite accumulation of events, collision detection, choice between event-driven and time-stepping schemes, etc.). Efficient methods and algortithms for the parametric continuations of solutions and identification of bifurcation points are also needed.

· **Toolbox for the design and validation of control strategies for nonsmooth systems.** The control of complementarity systems (and other formalisms for nonsmooth systems) is a rapidly expanding area of research We envisage the development of novel control techniques for nonsmooth complementarity systems (see below for further details) and the development of numerical routines to perform their validation.

· **Modular structure and user-friendly interface.** The numerical software we plan to develop should be modular and easy to expand with additional routines (or toolboxes). In contrast to some of the existing software, it should be easy to use through an interactive, user-friendly graphical interface.



USB Connectivity for Microcontrollers

The possibility of having a communication system between a personal computer and a microcontroller, microprocessor that initially lacks a data transmission interface, is undoubtedly a very useful tool in certain situations. The small-size of the components and the power supply of the device through a USB port (Universal Serial Bus) allows the design of a user-friendly interface.

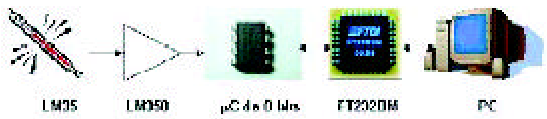


Fig. 5. Block diagram of the USB temperature measurement system

FT232BM. This provides the conversion of TTL levels coming from the microcontroller communication port to USB standard signals and also implements the connection, addressing, etc. protocol. The configuration «Bus Powered» is permitted because it can be powered between 4.35V and 5.25V. The integrated circuit supports the newest versions of USB as USB 1.1 and USB 2.0. The use of this integrated circuit provides USB connectivity to our system in a quick and easy way. This chip requires a 6MHz oscillator, which provides the needed frequency for USB communication.

MC68HC908QT4. This is an 8-bit microcontroller of the Motorola HC08 family, which integrates an analogdigital converter that will convert the signal, coming from the temperature sensor and send it by frames to FT232BM. We have used this microcontroller because of its small size, low power consumption and flexibility. Data is packed in a frame in series format with a start bit, 8 data bits, no parity and a stop bit. The frame is identical to one that we would send to a conventional RS232 port, but in this case the frame is sent to the FT232BM, which is in charge of sending the data to the USB port.

The software is composed of USB drivers which allow the operating system to receive the incoming data from this port, the compiler for the microcontroller programming and a software interface developed in LabVIEW which monitors the data coming from the device.

USB drivers. The USB devices can be connected in <<plug and play>>. The operating system recognizes the interface and requests from the associated controller. The controller used is the Virtual COM port and can be downloaded from the FTDI chip page.

The drivers used are suitable for W98, ME, 2000 and XP Operating Systems.

Microcontroller programming. The acquisition system and communication control software. The development environment is Metrowerks Code Warrior 2.1; the new CodeWarrior v3.0 version is also completely compatible.

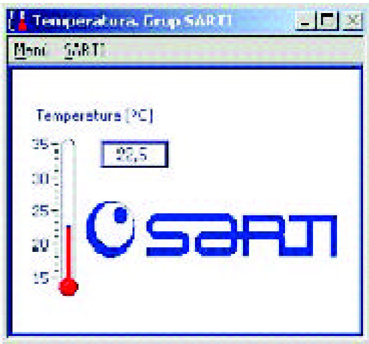


Fig. 6. Monitoring panel of temperature coming from the USB bus

Monitor software. In order to equip the system with a graphical environment, the graphical language LabVIEW has been used to implement a simple application to monitor the temperature values and to configure the communication parameters .Figure 6 shows the temperature-monitoring panel. Thanks to the drivers, data transmission will be programmed in the same way as it would have been if a conventional serial port had been used.

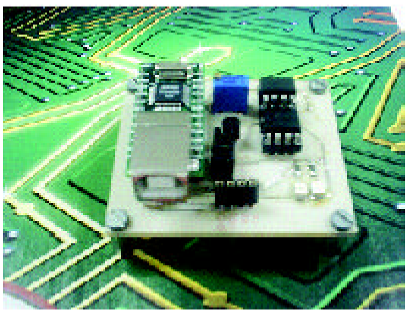


Fig 7. Prototype with USB interface

After evaluating different solutions of USB connectivity for new designs based on microcontrollers, a solution based on FT232BM integrated circuit, which provides a quick way of USB connection with microcontrollers that have SPI or UARTs communication ports, is presented. By using the USB bus,the speed at which the data is transferred from hardware to computer is increased and thanks to the configuration the system is powered through the communication bus. In figure 7 we can see a prototype, which uses a small evaluation kit for USB FT232BM interface.

Control of Monolithic Spectrometer

Applications for environmental monitoring

The use of spectroscopy as an analytical tool is widespread in all fields of science. In the past two decades there have been remarkable advances in the miniaturization of spectrophotometric systems components. Analyses that were once limited to the laboratory can now be used in the field for on-site chemical and biological analysis. Miniature spectrophotometry is capable of conducting research in the field and thus avoiding complicating sampling issues.

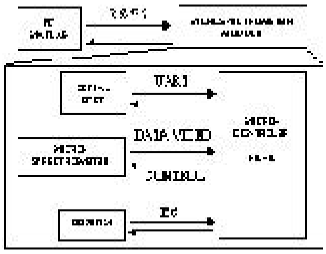


Fig 8. Modules of the microspectrometer control hardware.

Currently, there are numerous commercially available miniature spectrometer systems as well as discrete components that are used by researchers in designing their own systems. STEAG microParts offers a new monolithic micro-spectrometer, based on LIGA technology (the name comes from the initial letters of *Lithographie-Galvanoformung-Abformung* , the German words for Lithography, Electroforming and Moulding). This precise micro-molding and replication technique has matured to produce small structures with submicron sized features with optical quality surfaces. Its monolithic design ensures mechanical and environmental stability. The key features of these new microspectrometers are the extended spectral range, improved sensitivity and stability, very small size and lower cost. The light spectrum is generated by coupling the light through a silica fibre into the centre layer of the three-layer waveguide, which contains the moulded grating. The detector attached at the focal plane is a Hamamatsu photodiode array with 256 pixels.

A new module controls the microParts spectrometer. The control is based on the PIC18F452 and it is possible to store the data spectrum on an external EEPROM or transmit it through a serial port (fig 8).

Grafical User Interface on Matlab was designed for setting different hardware parameters such as integration time or number of averaged spectra (fig 9)

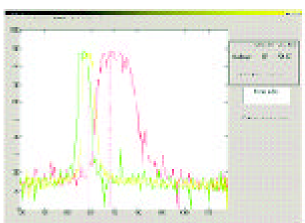


Fig 9. Matlab GUI interface.