

# Preface

Data acquisition system (DAQ) is used to acquire information from some physical phenomena. The main process is to sample the signals that convert the analog value (electrical signal) of the sensor to a digital one and be manipulated by a computer. What's the main components of the data acquisition system? The main electronic systems can be one of the following members:

- Sensors: to convert the physical phenomena in electrical signal
- Analog-to-digital converter: to convert analog signal to digital signal
- Multiplexer and amplifier: to switch and amplify the input's analog signals with an analog–digital converter in digital form
- Display/computer: to visualize/manage the data

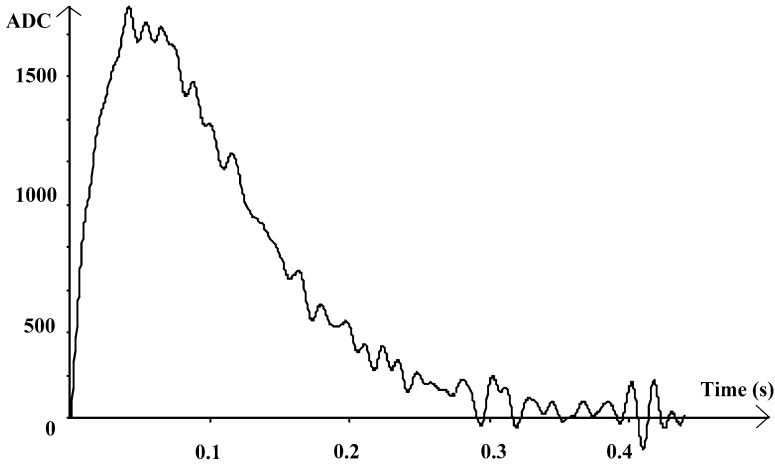
The complexity of new physics experiments requires more complex DAQ with the following characteristics:

- Capable of managing large amounts of data
- High-speed connection for DAQ
- Digital recording
- Full reconfigure possibility

Signals that are hard to characterize and analyze with a real-time display are evaluated in terms of the following parameters:

- High frequency
- Large dynamic range
- Gradual changes
- Sudden, unpredictable events (Fig. 1)

The goal of this book is to give the theory and practical information about the design of data acquisition systems; it helps to solve problems about the functional design hardware (and software). DAQ software allows us to communicate with and control the card; analyze and present the data. As for the software, here we will provide the general and basic concepts; the language programming details



**Fig. 1** Transient single shot event

for further elaboration are excluded. Each complex concept has been made in an easy-to-understand way which makes them readily usable. Handling the parameters is important for many industrial applications; main idea of data acquisition systems projects is to develop an application which can handle the sensitive parameters, such as temperature, humidity, and so on. Many of them use also GSM/UMTS/HSPDA technology or similar, though GSM provides voice and video calling facilities. Moreover, a possible high-speed DAQ will be described and we will analyze the theoretical aspects and possible configurations management by a computer through the main communication bus: USB and Wireless. In particular, it will be further discussed the design techniques introduced with functional design.

In the last year, some aspects are emerged to define the impacts of the evolution of the data acquisition system. For example, USB bus improves both of the ease of use and flexibility. Wireless has also a consolidation technology and standardization. For high-speed system, IEEE 802.11 has seen its adoption in mobile applications. Tablet computers will also be part of the future of DAQ systems, software has been and will continue to be the driver for many new application and technology changes for the future using more efficiently graphics user interface. Future of the data acquisition systems is based on the use of onboard field-programmable gate arrays (FPGAs). The flexibility makes them ideal not only for custom data acquisition requirements but also for embedded applications and the development and testing of custom digital device.

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