Designing a system for accurate testing and calibration of α and β measurement probes

Angelica Hedman (angelica.hedman@foi.se) and Jonas Boson (jonas.boson@foi.se)
Swedish Defence Research Agency (FOI), CBRN Defence and Security, Umeå, Sweden

1. Introduction

This poster describes the design of a system constructed to facilitate the calibration and test of alpha and/or beta measurement probes. Good knowledge about instrument response is essential both for the development of measurement methods and for the understanding and interpretation of measurement results.

2. Performance Requirements

The main objectives of the system are to:

a) increase precision and accuracy in the position of probe and source, i.e. to provide good repeatability;

b) enable an automated reading of the instrument display and audio signal; and

c) effectively reduce the spent time and need for personnel during the measurements.

More specifically, the system should be able to:

- Move the probe with different speeds ≤15 cm/s relative to the source
- Change distance between source and probe
- Handle sources with a contaminated area larger than the probe surface
- Operate with different probes
- Read the instrument display
- Register the audio signal
- Provide an output with results (i.e. display value and audio signal) together with position, speed, distance etc. in a text file for further analyses

3. Hardware & Software

The components of the system are schematically illustrated in Figure 1. Basically, it consists of a vertical track with probe holder, a horizontal track with source holder, two engines, a camera and a computer. The camera records images (31 frames per second) of the instrument display and sends data to the computer. The amplitude of the instrument's audio signal is registered through a microphone or directly via an audio output if such is present on the instrument.

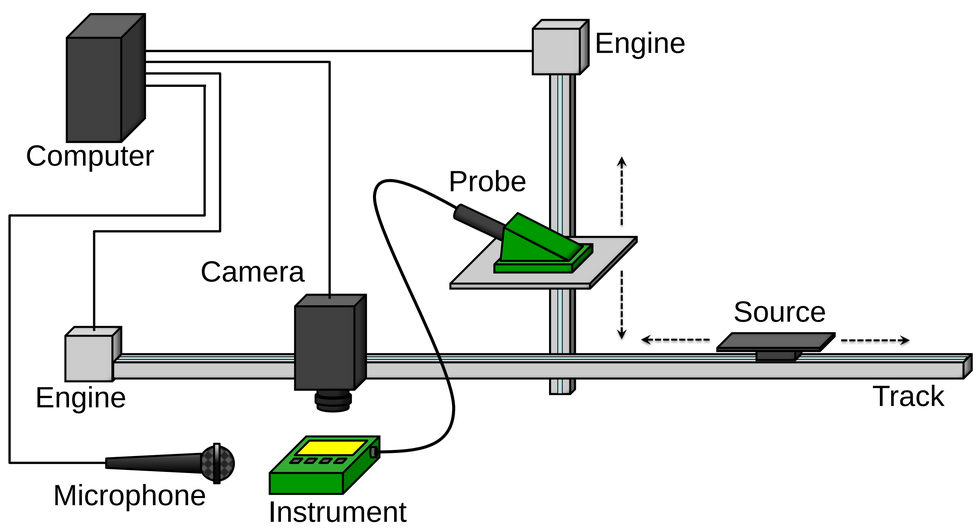

Figure 1. *Schematic illustration of the system design.*

LabView, a program from National Instruments, operates the various components. An OCR (optical character recognition) program, included in a module for LabView, is used for interpretation of images of the instrument display recorded by the camera; i.e. the displayed value is read from the image and written to a text-file.

When a measurement is finished the output with results (i.e. display value and audio signal) together with position, speed, distance etc. is shown in a text file. The text file is connected to the same time stamp as image files to simplify retrospective correction of possible errors.

4. Example of Results

To get an idea of what the system can provide, some results are shown in Figure 2. Measurements have been made with the Swedish Armed Forces instrument "Intensimeter 28" coupled to a hand-held combination probe, capable of measuring both alpha and beta radiation. The source was a glass surface of size 20x10 cm^2 coated with Am-241 with surface activity of 26.4±0.5 Bq/cm^2 (coverage factor k=2).

These results illustrate the capability of the designed system to display – and allow for a quantification of – instrument specific parameters, e.g. time delay in instrument response. From the graphs in Figure 2B one can see that there is up to 2.5 s or 25 cm delay in the response at 10 cm/s. In this case there is also a significant drop in the maximum instrument reading at higher speeds. There is, however, no obvious delay or decrease in the audio signal.

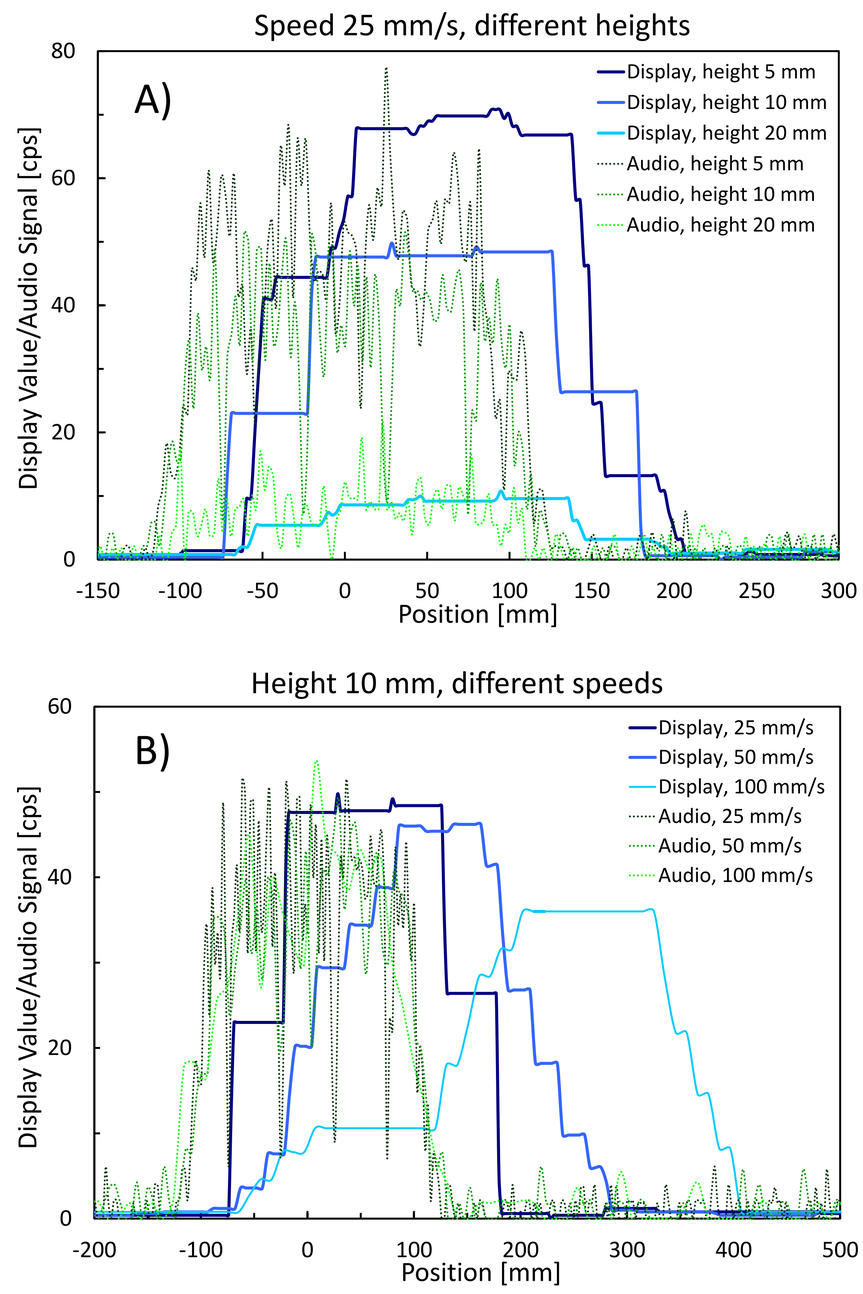

Figure 2. *Measurement results using the I28 and a combination (α and β) probe and a 26 Bq/cm^2 Am-241 source. The graphs illustrate how display values and audio signal changes at various distances (a) and speeds (b).*

5. Summary

A system has been designed that can significantly reduce the need for manual work during test and calibration of alpha and beta measurement instruments. As well as being time saving the new system shows good precision, accuracy and reproducibility.

The system is capable of alternating the source-to-probe distance as well as the relative speed of the source to the probe. It is capable of handling almost any type of instrument and probe.

FOI