

Experiment simulations (Virtual instrumentation) created using LABVIEW 6.1

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1. Introduction

LABVIEW, is a product of CORPORATION NATIONAL INSTRUMENTS, Austin, Texas, SUA, licenced to UNIVERSITATEA POLITEHNICA BUCURESTI , MINISTERUL EDUCATIEI, CERCETARII SI TINERETULUI, but for free use by the Romanian schools.

Using LABVIEW the following objectives can be realised:

- Use by teachers and students for the development of applications within the classes taken in schools and colleges ;
- The making of direct and demonstrative experiments during classes ; simulations of technic and scientific experiments for group or individual study ;
- The development of programming skills using G-graphic programming language, included in the facilities of the Labview enviroment, which is rather easy to grasp;
- The development of learning skills at a personalized rithme using this new work facility known as virtual instrumentation.

LABVIEW is presently a programming language, but it will develop into a useful scientific programming language for the future generations. Learning this programming language can be done easily and fast. Using the Internet for image and sound editing, the applications developed using this enviroment have given the best results: a computer can remotely control and command real processes in almost every field.

In physics, LABVIEW can be used in the following tasks:

- I. Experimental demonstrations
- II. Experiments done by students
- III. Physical phenomena simulations
- IV. Physics lessons and evaluations sent to far places

2. Presenting programmes

A number of programmes were developed using LABVIEW so that students can understand:

- What the law of motion means ;
- the laws of straight / accelerated motion
- meaning of path, acceleration , instantaneous velocity and mean velocity;

- meaning of coordinates , displacement, time, duration
- classification of motion depending of: trajectory, law of motion
- solving cinematics problems

Three programmes of mechanics are beeing presented, which can be used by students in the 9th grade:

- 1) *Oblic throw with v_0 from x_0, y_0 at α_0 with the horizontal*, which is launched from "ARUNCARE.vi"
- 2) *Simulation of a moving body on a inclined plane*, which is launched from "miscPlan.vi"
- 3) *Straight motion on OX, OY and bodies at rest*

- Motion only on OX : straight accelerated / slowed down / at constant velocity
- Motion only on OY : straight accelerated / slowed down / at constant velocity
- Motion on both OX and OY which is lunched from "MISCARI.vi"

The three programmes can be combined.

For usage of these simulations, the user must know some basic knowledge:

I. Lanching and using the working programme

II. Vizualizing the tool bar

III. The usage of the folowing tools:

- *operating*
- *scroll*

III. Inputing data and reading results

IV. Special features for graphs:

- a) *Cursor list*
- b) *graph palette*
- c) *moving the cursor and viewing results*

The „Oblic throw with v_0 from x_0, y_0 at α_0 with the horizontal” programme :

- 1.** is launched from "ARUNCARE.vi"
- 2.** the following data is inputed :
 X_0, Y_0, V_0, α_0 – within the programme's range
- 3.** the "Run" button is clicked several times until the results remain constant
- 4.** the following data is given :

$T_{urcare}, T_{coborare}, T_{total}, H_{max}, V_{y0}, V_{x0}$

5. The following graphs are followed :

- a) X and Y as function of time ;
- b) V_x and V_y as function of time ;
- c) $Y = f(X)$

- 6.** Certain results may be obtained, certain calculations may be made and conclusions drawn, for instance:
 - Calculating acceleration on OY and OX

- Characteristics of the motion on both axes
- Calculating the displacement and it's maximum value, and the angle under which the throw was made
- Formulas for calculating velocities : V_x , V_y si V – speed
- Equation of the motion on OY and OX
- Trajectory equation
- Variation of α during motion

I. A particular case is the motion on a vertical path:

- Throwing a body upward
- Free fall

Students can make similar studies in these situations:

- Calculating the time needed for the body to move upward and downward
- Maximum height depending on v_0 and Y_0

The „Simulation of a body's motion on an inclined plane” programme:

1. is launched from “miscPLAN.vi”

2. the following data is inputed :

X_0, V_0, α, μ – within the programme's range

X_0 – is measured from the bottom of the plane and has only positive values

V_0 – has values greater than or equal to 0

Particular case : $\alpha = 90$

3. The type of motion is chosen :

- upward
- downward

4. the „Run” button is clicked several times until the results remain constant

5. the following data is given :

Φ – angle of friction, $t_{coborare} / t_{urcare}$, $a_{coborare} / a_{urcare}$

In a textbox „type of movement” the resulting motion is characterised

6. The following graphs are followed :

- X as a function of time;
- V as a function of time;

7. Certain results may be obtained, certain calculations may be made and conclusions drawn, for instance:

- Type of motion depending on the inputed data
- Determining acceleration
- Maximum displacement as a function of α, μ, V_0

V_0

• Relationship between Φ and motion on an inclined plane

• Relationships between time and other parameters

- Motion law
- Equation of speed

➤ A particular case is the motion on a vertical path:

- Throwing a body upward
- Throwing a body downward
- Free fall

The “Straight motion and bodies at rest” programme :

1) is launched from “MISCARI.vi”

2) from “LIST BOX” one of the following choices is selected

- Motion only on OX
- Motion only on OY
- Motion on both OX and OY

3) The following data is given :

- acceleration a_x / a_y or a_x & a_y
- time t
- initial coordinates: x_0 / y_0 or x_0 & y_0

d) viteza v_0 si unghiul α_0 cu axa OX

4) the “ RUN” button is clicked several times until the results remain constant

5) The results are displayed :

a) in one or two textboxes information is given about the type of motion on the axis

b) initial velocities on the axis, v_{x0} / v_{y0} or v_{x0} & v_{y0}

c) final coordinates: x, y

d) graphs :

I. $v_x = f(t) / v_y = f(t)$ or $v_x = f(t)$ & $v_y = f(t)$ and $v = f(t)$

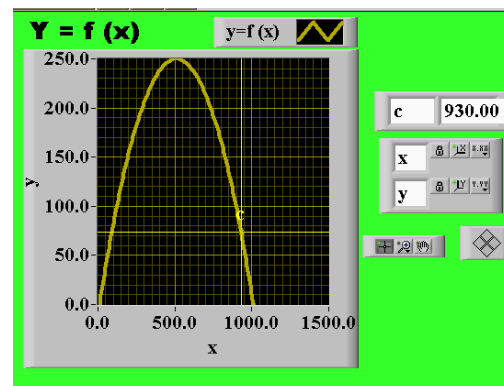
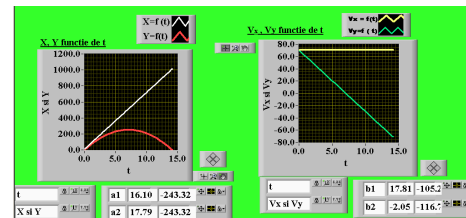
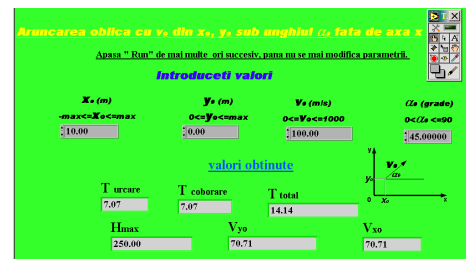
II. $x = f(t) / y = f(t)$ or $x = f(t)$ & $y = f(t)$ and $y = f(x)$

6) Certain results may be obtained, certain calculations may be made and conclusions drawn, for instance:

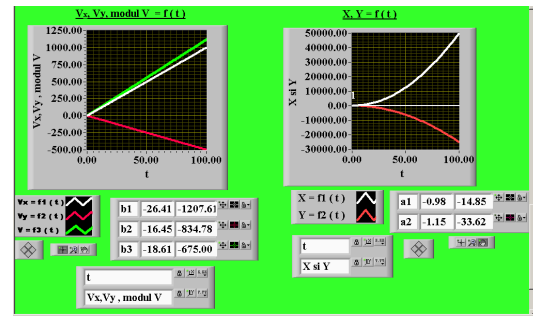
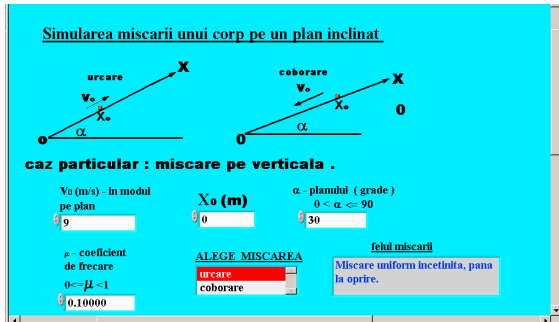
- Mean and instantaneous velocity
- Determining the distance using the area under the graph
- Comparing the straight motion with plane motion
- Combining uniform / accelerated motions on both OX and OY

IMAGES :

From „Oblic throw with v_0 from x_0, y_0 at α_0 with the horizontal” :



From „Simulation of a body’s motion on an inclined plane”:



3. Conclusions

- ♣ Students learn physics in an easy and attractive format
 - ♣ They use the computer, a modern way of teaching and learning
 - ♣ The graphic-programming environment LABVIEW has design and fast programming facilities
 - ♣ Students develop skills not only in Physics, but also in Informatics
 - ♣ The programmes help students understand additional Mathematics notions, such as: functions, graphs etc.
 - ♣ The programmes can be modified / improved.
 - ♣ Using LABVIEW, new programmes can be developed working with Physics , Mathematics and Informatics teachers and students
- The programmes were realised using LABVIEW 6.1.
We are waiting for observations, comments or criticisms.

Note :

The presentation of the associated programmes will be made by prof. Sporea Dan, Head of Laser Metrology and Standardisation Laboratory National Institute for Laser, Plasma and Radiation Physics, Magurele, Romania, who is part of the organising committee of “1st International Conference on Hands on Science Teaching and Learning Science in the XXI Century” and takes part in the work sessions.

The software will be written on a CD.

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Din programul “Miscari rectilinii si repaus” :

