Contribution ID: **70**   Type: **not specified**

Physics and mathematics using and designing machines and mechanisms

Wednesday, 6 September 2023 18:15 (20 minutes)

Identification and characterization of the interacting systems in the analysis of physical phenomena is a teaching strategy that facilitates:
- the examination of the significant variables in the evolution of a phenomenon;
- the distinction between state and interaction variables;
- the recognition of cause and effect relationships.
We present educational activities that we have been experimenting with for years at school and university based on the use and design of machines and mechanisms. The activities are framed in a didactic strategy that aims to recognize mathematical and physical principles. Analysis of geometric and motion transformations (i.e. linear vs circular) and transduction processes constitute an opportunity for students to master key concepts of mathematics and physics and to develop, at the same time, articulated technological skills. In mathematics, mechanical drawing machines are useful tools for the study of remarkable curves such as conic sections. In physics, the analysis of the internal working of machines and measurement devices is a great opportunity to clarify the relationship between theoretical entities and measurement processes. In the modeling process, familiarity with machines (old and contemporary) and transducers has a great cognitive value: the mechanical metaphor lies at the heart of every cause-and-effect reasoning and is of the highest importance in physics.

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Session Classification: Da Poleni a B. Rossi e oltre / From Poleni to B. Rossi, and Beyond: 20th Century

Track Classification: SISFA 2023