FROM FEAR TO FUN IN THERMODYNAMICS: The Partial Derivative Machine (PERC 2013)

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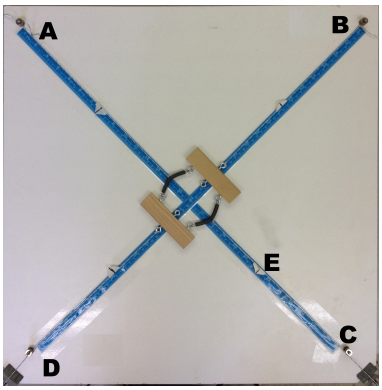
The Activity

The Partial Derivative Machine is shown below.



The X direction is from B to D (as pictured above), and the Y direction is from A to C. The physical variables for the Partial Derivative Machine are:

1. x: distance between the flags on the X strings
2. y: distance between the flags on the Y strings
3. F_x: tension in the X strings
4. F_y: tension in the Y strings

Isoforce and Isowidth Stretchabilities

Find the following derivatives using the Partial Derivative Machine:

1. Measure the isoforce stretchability of your system.

$$\left(\frac{\partial x}{\partial F_x}\right)_{F_y}$$

2. Measure the isowidth stretchability of your system.

$$\left(\frac{\partial x}{\partial F_x}\right)_{y}$$

3. Are these derivatives the same?

For further information about this session, scan the QR code at the right, or navigate to:
`http://physics.oregonstate.edu/portfolioswiki/workshops:perc13:start`
or contact David Roundy `<roundyd@physics.oregonstate.edu>`.

Solution

Isoforce stretchability

We find the isoforce stretchability by hanging a fixed weight on the y axis, and measuring x for a few smallish weights F_x. We need to choose changes in F_x that are large enough that we can accurately measure Δx, but small enough that the response is linear.

Isowidth stretchability

To find the isowidth stretchability, we screw down the y string, to fix the width in that direction, and measure the derivative as above.

Are they the same?

In general, no. It will depend on the details of the system being studied.

Further information is available in "The Partial Derivative' Machine" by Grant Sherer, Mary Bridget Kustusch, Corinne A. Manogue, and David Roundy, submitted to PERC13 and available on the website on the previous page.