Computational physics without starting from the differential equations

Enzo Tonti

Università di Trieste, Trieste, Italy

From the birth of the differential calculus we are accustomed to write the physical laws in terms of differential equations. Since, in general, we are not able to find an analytical solution we must resort to a numerical solution. This requires a preliminary discretization in order to obtain an algebraic system, that can be solved by a digital computer. Today, making use of elementary and intuitive notions of algebraic topology, such as those that make reference to the cell complexes, it is possible to express the physical laws directly in algebraic terms so to avoid any discretization procedure. This keeps the algebraic formulation very adherent to the physical fact thus avoiding a series of problems and of conditioning that arise in the various discretizations of differential equations.