More then three centuries ago, more precisely in 1686, Sir Isaac Newton, one of the foundation–stones of human thought (see [AM78]), in his famous book ‘Philosophiae Naturalis Principia Mathematica’, stated the metaphysical and physical basis of modern sciences, including CSB (in spite of the influences of modern physics).

Methodology of all sciences tries to solve two main problems: explanation and prediction. The problem of explanation (or basic understanding of the structure and function of the object in consideration) has been (more or less successfully) solved by both natural and social sciences. But the problem of prediction has been (in a limited range) solved only by the so–called ‘exact sciences’ with developed mathematical, measurement, and computer simulation equipment.

Any form of prediction in science is based on Newton’s principle of causality. We can even say that the human thought apparatus is based on this (meta)physical principle.

Newton’s principle of causality (Figure 2.1) states:
If the initial state (in any chosen initial time) of any CSB–system is known (measured on the system S–axis), and if all the influences upon the system considered are known from the initial time on (measured on the time t–axis), then the future behavior of the system (its ‘destiny’) is completely determined.

More precisely Newton’s causality principle can be formulated thus:
If the law (i.e., the balance) of forces acting upon the system is known together with its initial conditions, than the law of motion (or, generally, behavior) can be obtained exactly (by solving, either analytically or numerically, the system equations for the given initial conditions).

For the sake of mathematical formulation of the causality principle Newton invented (independently of a mathematician– philosopher G.F. Leibnitz) differential and integral calculus. The basic geometric idea of differential calculus consists of the limiting process which transforms bilocally (i.e., in two distinct space and/or time points) defined classic vector quantity (representing some...
average force, velocity or acceleration) into \textit{uniloco}ally defined tangent vector (representing instant force, velocity or acceleration). The process of obtaining the tangent vector in each point of a curve is called differentiation, while the inverse process is called integration. Differentiation of the time–dependent trajectory with respect to time gives the curve of velocity, and differentiation of the later gives the curve of acceleration. Geometric construction of the tangent vector in each point of the curve is the special case of construction of the tangent bundle on the smooth manifold (a smooth curve is a one-dimensional smooth manifold, surface is two–dimensional, and so on). The projection of the tangent bundle on the original manifold represents the process of (indefinite) integration.

Newton’s crucial second law of motion (see [AM78]– [MR94]) says: the force acting on any CSB–system is proportional to the time rate of change of velocity of the system, and the proportionality constant is the measure of inertia of the system. Simplifying this statement, we have: the force acting upon the system is equal to the product of its mass and its acceleration. Formally: \[ F = ma = m\dot{v} = m\ddot{x}, \]
where overdot denotes the time derivative (i.e., tangent vector in the given point of the curve, or the time rate of change of the quantity considered), \( F \) represents the force, \( m \) – the mass, \( a \) – the acceleration, \( v \) – the velocity, and \( x \) – the position coordinate.

This equation implies some frame of reference with respect to which the acceleration \( a = \dot{v} = \ddot{x} \) is measured. It is a fact of experience that Newton’s law of motion expressed in this simple form gives results in close agreement with experience when, and only when, the coordinate axes are fixed relative to the average position of the ‘fixed’ stars moving with uniform linear velocity and without rotation relative to the stars. In either case the frame of reference is referred to as an inertial frame and corresponding coordinates as inertial coordinates.

Newton’s causality principle can be now reformulated as: if the law of force \( F = F(t) \) is known together with the initial conditions \( x_0 = x(0) \) and \( v_0 = v(0) \), then the solution of upper (differential) equation of motion gives the law of motion \( x = x(t) \).