Oscillations represented as a transformation problem of matrix functions

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Abstract

Oscillations are usually represented as the solution of a differential equation of second order. From this conventional form of the solution, it is not evident at once that the oscillating system goes over from a state at the beginning to a state at a later time by transformation of the components. In the here referred article it is demonstrated, that oscillations can definitely be characterized as a problem of transformation by means of matrices, which reproduces completely the classical solution of the oscillation differential equation. The oscillation is regarded as a reaction process, which is simulated in a functional sequence of small steps establishing the resolving matrix by expansion of a matrix exponential series. There is no need for the solution of any eigenvalue problem. The application of matrices, moreover, proves to be especially suitable for the analytical treatment and numerical calculation of coupled oscillators. Coupling is investigated by the resonance of an oscillator on excitation of external oscillations. By this way one can describe even extended systems of coupled oscillators like atoms and molecules in a crystal lattice in different mutual relations and spatial arrangements. The matrix version to treatise oscillation processes offers the advantage that it could be adjusted to the well-developed methods of the solution of interacting reaction systems, the calculating algorithms of which are already at disposition. In such a reaction system an oscillator is represented as a reacting component by a two-row elementary submatrix of the type of PAULI's spin matrices. Thus, also the combination with other – e.g., physical, chemical, or biological – reaction systems and the simultaneous solution of them is possible.

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