A Principle of Conservation of Relational Energy

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Abstract

In classical mechanics, this paper presents a principle of conservation of relational energy which can be applied in any reference frame without the necessity of introducing fictitious forces.

The Principle of Conservation

The kinetic energy K of a system of N particles of total mass M, is given by:

$$K = \sum_{i=1}^{N} \sum_{j>i}^{N} \frac{m_i m_j}{M} \left(\dot{r}_{ij} \dot{r}_{ij} + \ddot{r}_{ij} r_{ij} \right)$$

The principle of conservation of relational energy states that in an isolated system of N particles that is only subject to conservative forces (of action and reaction and proportional to $1/r^2$) the relational energy of the system of particles remains constant.

$$K + U = constant$$

where $r_{ij} = |\vec{r}_i - \vec{r}_j|$, $\dot{r}_{ij} = d|\vec{r}_i - \vec{r}_j|/dt$, $\ddot{r}_{ij} = d^2|\vec{r}_i - \vec{r}_j|/dt^2$, $\vec{r}_i$ and $\vec{r}_j$ are the positions of the i-th and j-th particles, m_i and m_j are the masses of the i-th and j-th particles. U is the internal potential energy of the isolated system of particles.

Bibliography

E. Schrödinger. Die Erfüllbarkeit der Relativitätsforderung in der klassischen Mechanik. Annalen der Physik, 1925.

A. K. T. Assis. Relational Mechanics and Implementation of Mach's Principle with Weber's Gravitational Force. Apeiron, 2014.

V. W. Hughes, H. G. Robinson, and V. Beltran-Lopez. Upper Limit for the Anisotropy of Inertial Mass from Nuclear Resonance Experiments. Physical Review Letters, 1960.