Classical Physics

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※ Lecture 1 (1/21)

1.1 Constraints

A constraint can be defined as a rule, parameter or a limitation that the system on which it is imposed on must follow. Constraints can be classified into the following:

1.1.1 Holonomic

If the equation of constraint acting on a system of N particles can be expressed in the form $f(r_1, r_2, r_3, ...) = 0$ relating the coordinates and time, the constraint is called a Holonomic constraint.

1.1.2 Non-Holonomic

If the constraint cannot be expressed in the $f(r_1, r_2, r_3, ...) = 0$ form and involves an inequality sign, the constraint is called Non-Holonomic.

1.1.3 Scleronomic

The Constraints that are independent of time are classified as scleronomic constraints.

1.1.4 Rheonomic

Constraints that contain time as an explicit variable, i.e dependant on time are called rheonomic constraints.

1.2 Generalized coordinates

For a system of N particles, 3N coordinates are required to define it completely. If there are 'k' equations of Constraints, the number of degreese of freedom are reduced to $3N - k = n$. Thus we require N independent coordinates $\{q_1, q_2, ..., q_n\}$ to specify define the system. This set of N coordinates are called generalized coordinates. The transformation equation of the system can be expressed in terms of Generalized equations as

$$r_i = r_j\{q_1, q_2, q_3, ..., t\}$$

Where j=1, 2, 3 . . .

For a particle moving on the surface of a sphere, generalized coordinates are $\{\theta, \phi\}$ as the system has two degrees of freedom. For a bird flying through the sky, the generalized coordinates is $\{x, y, z\}$.

1.3 Second subsection

References

[1] Herbert Goldstein *Classical Mechanics*.