

Chapter 1 Introduction

1.1 Introduction

Today is 20211211, and I decided to note down all of my knowledge about physics in this notebook. Actually we think for a while whether to separate the knowledge into different documents.

1.2 Preference

1.2.1 Vocabulary

orthogonal matrix, 正交矩阵

Chapter 2 Classical Mechanics

2.1 Classical Mechanics

2.1.1 Center of Mass

Algebra definition $\mathbf{r}_c := \frac{\sum m_i \mathbf{r}_i}{\sum m_i}$, it relays to the choice of the coordinate system. If the map of the two coordinate systems is $T : S \rightarrow S'$, the matrix is orthogonal matrix, and m_i has no influence to the space, $\mathbf{r}'_c = T\mathbf{r}_c$.

The operator \mathbf{r}_c simplifies the calculation, $(\sum m_i)\mathbf{r}_c = \sum m_i \mathbf{r}_i$. We define the energy of the system like this, the whole energy $E_{all} := \sum \frac{1}{2} m_i \mathbf{v}_i^2$, the explicit energy $E_{ext} = \frac{1}{2} (\sum m_i) \mathbf{v}_c^2$, the intrenal energy $E_{int} := \sum \frac{1}{2} m_i (\mathbf{v}_i - \mathbf{v}_c)^2$, because $\sum m_i \mathbf{v}_c^2 - 2 \sum m_i \mathbf{v}_i \mathbf{v}_c = -\mathbf{v}_c^2 \sum m_i$, we have $E_{int} = E_{all} - E_{ext}$.

2.1.2 Momentum

$\sum m_i \ddot{\mathbf{r}}_i = \sum (\mathbf{F}_i + \sum \delta_{ij} \mathbf{f}_{i \leftarrow j}) = \sum \mathbf{F}_i$. We define momentum $\sum \mathbf{P}_i = \sum m_i \dot{\mathbf{r}}_i$, therefore, $\frac{d}{dt} \sum \mathbf{P}_i = \sum \mathbf{F}_i$. [So the speed of light is always a const number, means that no other force can be applied to light?]

$$\int \frac{d\mathbf{p}}{dt} = \mathbf{F}, \text{ so } \int d\mathbf{p} = \int \mathbf{F} dt.$$

2.1.3 Rigid Body

A rigid body changes from one position and orientation to another, the general movement can be represented as $\mathbf{v} = \boldsymbol{\omega} \times \mathbf{r}$.

Proposition 2.1 (One fixed rotation axis). *Proof that the transformation of a rigid body has one fixed rotation axis.*

As shown in the figure, supposed that point A and B are on a sphere, and are transformed to A' and B', and two perpendicular bisector lines meets at point N, the point N can be transformed to N', because that $\triangle ABN \cong \triangle A'B'N'$, and moving on the orientable surface the triangular

cannot be transferred from $\triangle ABC$ into $\triangle ACB$, we say $N = N'$, the line ON is the axis that doesn't move during the transformation.

The basis of the coordinate system $\mathbf{Z}^T := [e_1, e_2, e_3]$, represented as one line and three columns. The transformation of the basis $\mathbf{Z}' = \mathbf{Z}\mathbf{\Gamma}$, $\mathbf{Z}\mathbf{\Gamma}\mathbf{r}' = \mathbf{Z}\mathbf{r}$, so $\mathbf{r}' = \mathbf{\Gamma}^{-1}\mathbf{r}$, $\mathbf{\Gamma}\mathbf{\Gamma}^{-1} = \mathbf{I}$ is easy to say when we write left in detail and considering that the $\mathbf{\Gamma}$ is the unit orthogonal base. Then the $\mathbf{\Gamma} \in SO_3$.

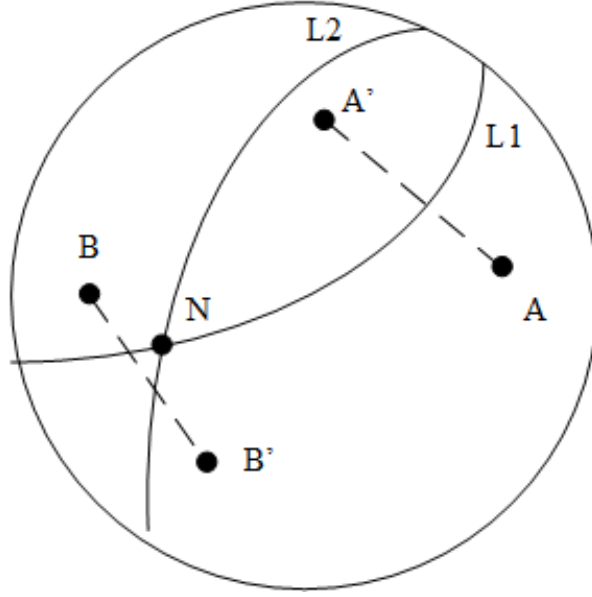


Figure 2.1: [T0004:ProvehasOneAxis]

The eigen value of $\mathbf{\Gamma}$, $|\mathbf{\Gamma} - \lambda\mathbf{I}| = 0$, so $-x^3 + \alpha x^2 + \beta x + 1 = 0$, since the image of the function is continuous through $(-\infty, +\infty)$, it must have one root. 1 is one of the root. If the three roots are all real, they are all 1, or 1,-1,-1. If the rest two roots are virtual, they are $e^{i\theta}, e^{-i\theta}$, so $T\phi = e^{i\theta}\phi$.

$$\mathbf{\Gamma}(\phi_1 + i\phi_2) = e^{i\theta}(\phi_1 + i\phi_2),$$

$$\mathbf{\Gamma}(\phi_1 - i\phi_2) = e^{-i\theta}(\phi_1 - i\phi_2)$$

therefore :

$$\mathbf{\Gamma}(\phi_1) = \cos(\theta)\phi_1 - \sin(\theta)\phi_2,$$

$$\mathbf{\Gamma}(\phi_2) = \sin(\theta)\phi_1 + \cos(\theta)\phi_2$$

θ is the rotation angle.

(2.1)

2.1.4 Anglar Momentum

$\mathbf{L}_i := \mathbf{r}_i \times \mathbf{p}_i$, with the definition of \mathbf{p} , we have $\sum \mathbf{L}_i = \sum m_i \mathbf{r}_i \times \mathbf{v}_i$, and $\sum \mathbf{L}_i = \sum \mathbf{r}_i \times \mathbf{F}_i + \sum \mathbf{r}_i \times \sum_j \mathbf{f}_{i \leftarrow j}$. Since $\sum (\mathbf{r}_i - \mathbf{r}_j) \times \mathbf{f}_{i \leftarrow j} = 0$, we have $\sum \mathbf{L}_i = \sum \mathbf{r}_i \times \mathbf{F}_i$. We also call that Torque.

2.2 electromagnetics

The energy is flowing through the space around the conductor.

2.3 Reference

2.3.1 Todo

2.3.2 Tmeplate

Tmeplate

Theorem 2.1 (均值不等式). 设 A, B 是两个实数, 则 $2AB \leq 2A^2 + B^2$.

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□

The free fall ball ends at $[1 - |(\mu k)^{-1} \pmod{2} - 1|]kH$

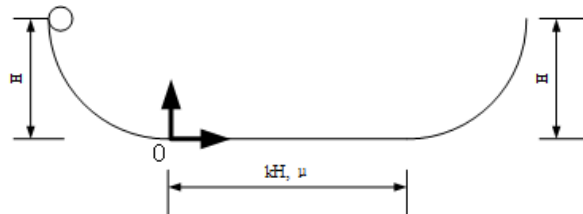


Figure 2.2: [T0001:]