Advanced Dynamics
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Module No # 10
Lecture No # 46
Introduction to Analytical Dynamics's: Generalized Coordinates-I

In this lecture I am going to introduce the analytical dynamics formulation using the analytical mechanics developed by Lagrange.

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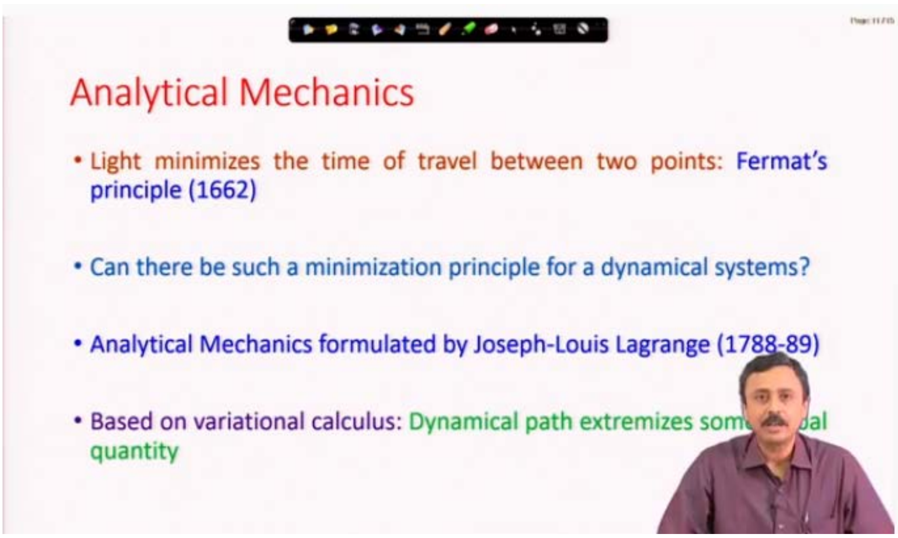

We will look at the introduction to analytical dynamics define what is the configuration space of a dynamical. Define the generalized coordinates to represent the configuration of a dynamical system on talk little bit about constraints. Analytical mechanics was formulated by Joseph Louis Lagrange around 1788-89. This is based on the calculus of variations.

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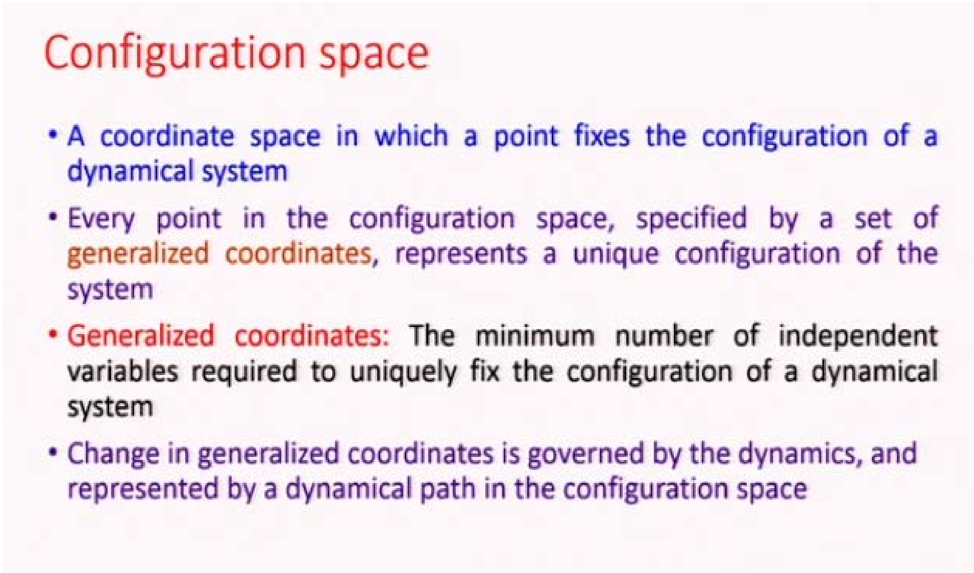

The definition and characteristics of configuration space is described in the slide above.

In the following slides, examples of some dynamical systems are considered and the corresponding configuration space geometry is discussed.

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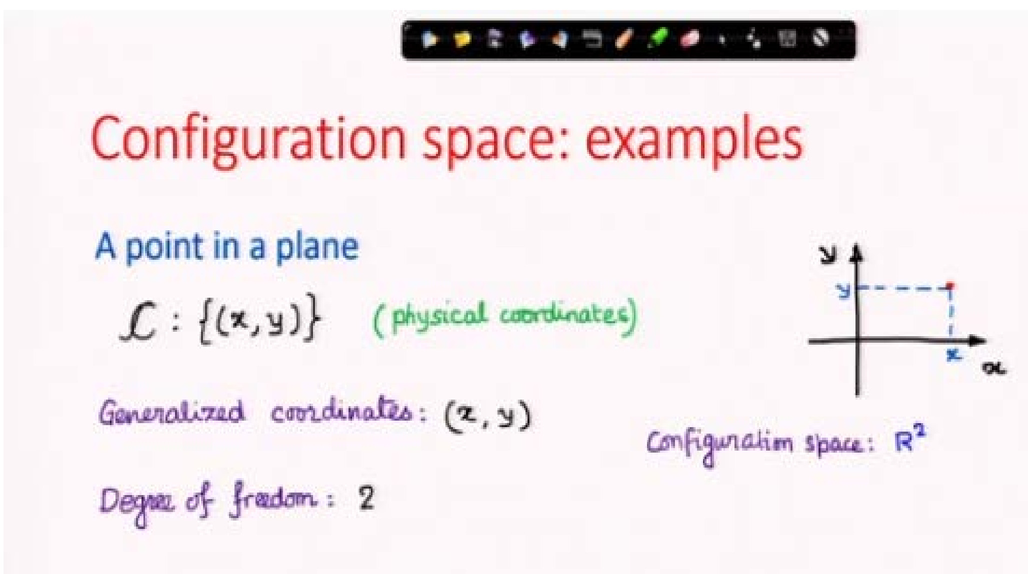

The configuration space of a point on a plane is discussed above.

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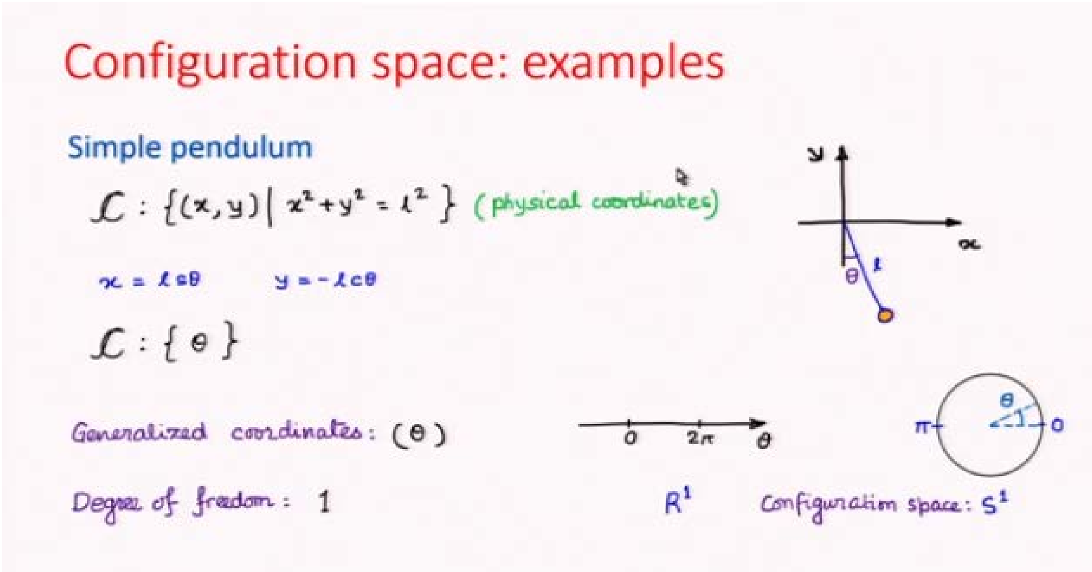

Let us now look at the configuration space of a mathematical pendulum as shown above.

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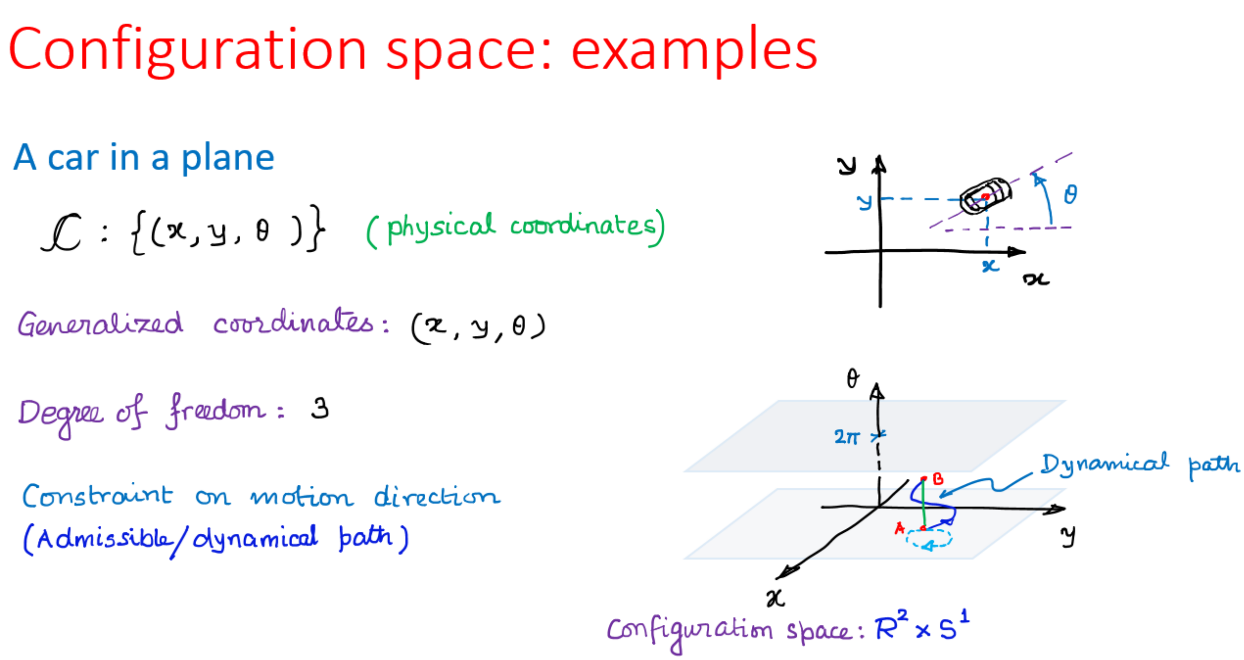
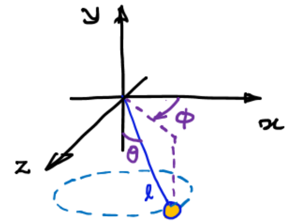


Configuration space: examples

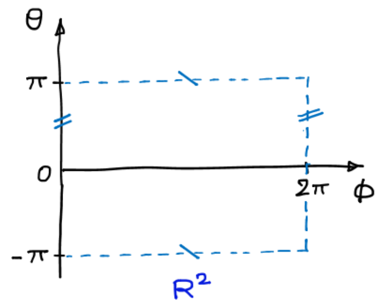
Conical pendulum

$\mathcal{C} : \{(x, y, z) \mid x^2 + y^2 + z^2 = l^2\}$ (physical coordinates)



$x = l\,s\theta\,c\phi \quad y = -l\,c\theta \quad z = l\,s\theta\,s\phi$

$\mathcal{C} : \{(\theta, \phi)\}$

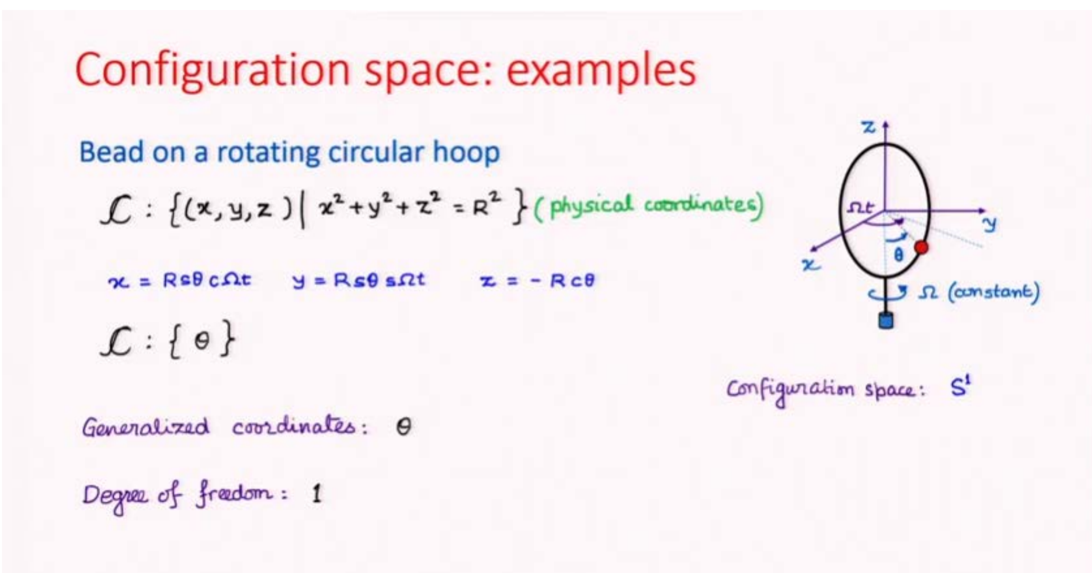


Configuration space: T^2

Generalized coordinates: (θ, ϕ)

Degree of freedom: 2

Conical pendulum example is discussed above.



A bead on the rotating circular hoop this is a circular hoop on which a bead can slide is considered in the above slide.

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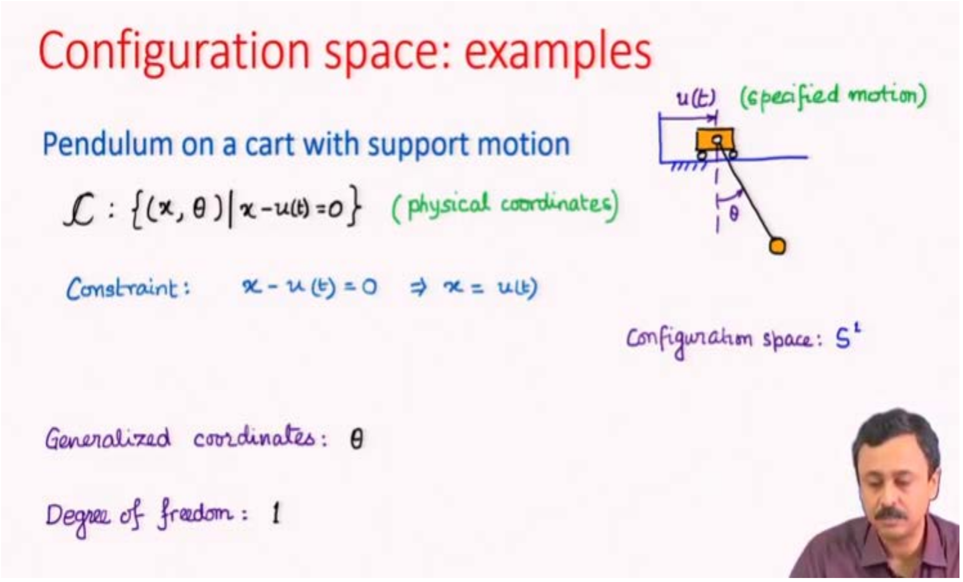

Pendulum on a cart is considered above.

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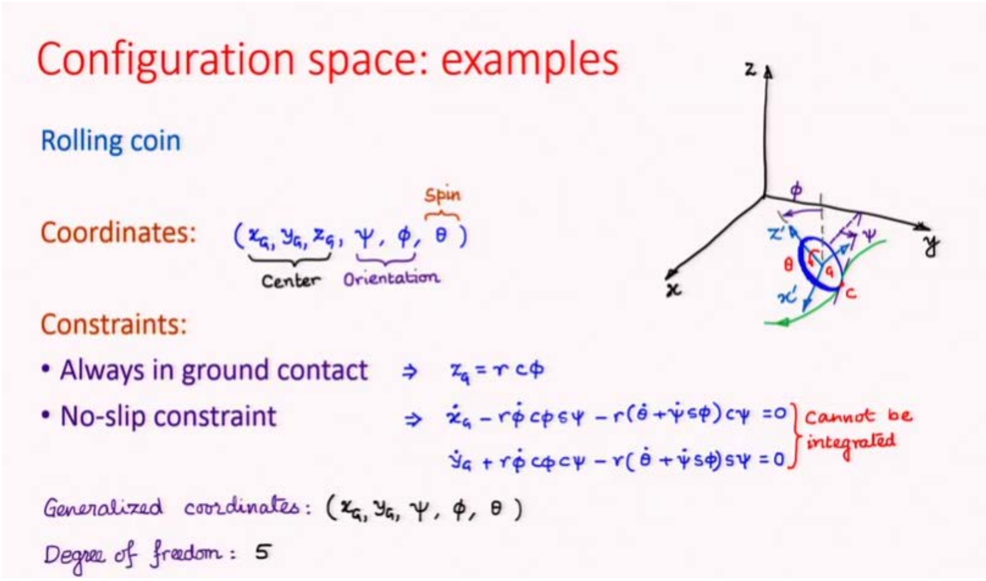

We discuss the configuration space of a rolling coin in the slide above.

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Summary

- Introduction to Analytical Dynamics
- Configuration space
- Generalized coordinates
- Constraints