Part I

A First Course in General Relativity[1]

Chapter 1

Special Relativity

On "Principle of relativity (Galileo)"

Galilean invariance

Newton's laws of motion hold in all frames related to one another by a Galilean transformation. In other words, all frames related to one another by such a transformation are inertial (meaning, Newton's equation of motion is valid in these frames).[2] The proof has been given by the book on page 2.

1.5 - Construction of the coordinates used by another observer

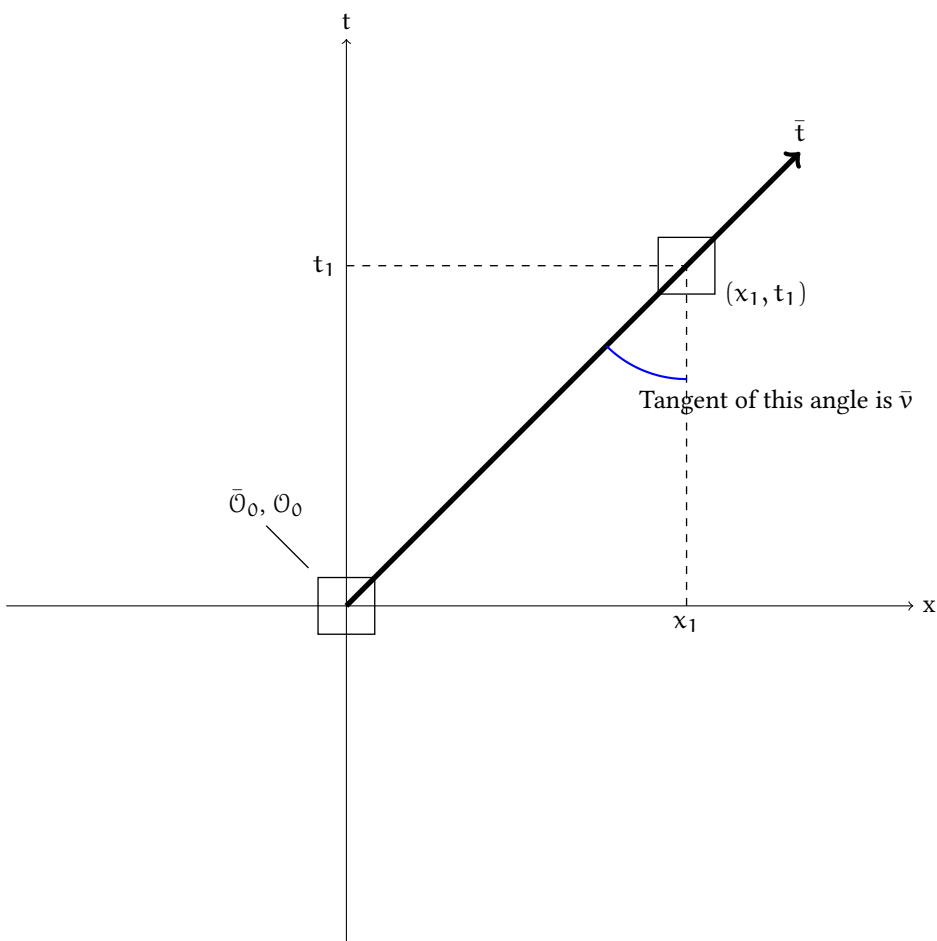### Why would the tangent of the angle is the speed in Fig. 1.2?

Suppose $\mathcal{O}$ and $\bar{\mathcal{O}}$ both start out at the same position where $\bar{\mathcal{O}}$ moves along the x at some speed. After t_1, observer $\mathcal{O}$ sees $\bar{\mathcal{O}}$ at position x_1:

$$\bar{\mathcal{O}}_1 = (x_1, t_1)$$

Observer $\bar{\mathcal{O}}$, however, still sees themself at $x = 0$:

$$\bar{\mathcal{O}}_1 = (0, t_1)$$

By definition where "$\bar{t}$ is the locus of events at constant $\bar{x} = 0$", $\bar{t}$ is the straight line that passes the origin and the (x_1, t_1):

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The diagram shows a t–x coordinate system with a $\bar{t}$ axis drawn as a bold arrow from the origin. The origin is labeled $\bar{\mathcal{O}}_0, \mathcal{O}_0$. A point (x_1, t_1) lies on the $\bar{t}$ axis, with dashed lines to t_1 on the t axis and x_1 on the x axis. A blue arc marks the angle, with the note "Tangent of this angle is $\bar{v}$".

1.6 - Why $(\delta x)^2 + (\delta y)^2 + (\delta z)^2 - (\delta t)^2 = 0$?

Bibliography

[1] Bernard Schutz. *A First Course on General Relativity*. 2009.

[2] Wikipedia. Galilean invariance.