A Simple Derivation of Lorentz Transformation based on Length Contraction

Using Galilean transformation   x' as measured by an observer O' moving at constant velocity relative to stationary (relative to Earth) observer O is:

$$x' = x - vt \quad [1]$$

According to the stationary observer O', X' appears contracted and , using the well known Lorentz-Fitzgerald contraction, it is:

$$x'\sqrt{1-\frac{v^2}{c^2}} = x - vt \quad [2]$$

If we solve for x' we get the Lorentz transformation form X' to X and vice versa.

$$x' = \frac{x - vt}{\sqrt{1-\frac{v^2}{c^2}}} \quad [3)$$

$$x = \frac{x' + vt'}{\sqrt{1-\frac{v^2}{c^2}}} \quad [4]$$

We can solve for t' an/or t using equations [3] and [4] and obtain the Lorentz transformation for time (t and/or t')

$$t' = \frac{t - \frac{vx}{c^2}}{\sqrt{1-\frac{v^2}{c^2}}} \quad [5]$$

The inverse transformation for [5] is;

$$t = \frac{t' + vt'}{\sqrt{1-\frac{v^2}{c^2}}} \quad [6]$$

Since the relative motion is restricted to x, y'=y and z'=z. This concludes the derivation for Lorentz transformation. There a variety of derivations based on the two postulates of special relativity that requires more algebraic work.