PEU 453 Assignment 3

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1   Problem 3.1

a.

$$x(\tau) = \frac{1}{g}[\cosh(g\tau) - 1]$$

$$\frac{dx(\tau)}{d\tau} = \sinh(g\tau)$$

b.

$$u^x = \frac{dx(\tau)}{d\tau} = \sinh(g\tau)$$

$$u.u = (u^x)^2 - (u^t)^2 = -1$$

$$\sinh^2(g\tau) - (u^t)^2 = -1$$

$$u^t = \sqrt{1 + \sinh^2(g\tau)} = \cosh(g\tau)$$

c.

$$v_x = \frac{u^x}{u^t}$$

$$v_x = \frac{\sinh(g\tau)}{\cosh(g\tau)} = \tanh(g\tau)$$

where tanh does not exceed one 1.

d.

$$u^t = \frac{dt}{d\tau}$$

$$\int_0^t dt = \int_0^\tau u^t(\tau)d\tau$$

$$t = \int_0^\tau \cosh(g\tau)d\tau$$

$$t = \frac{1}{g}\sinh(g\tau)$$

$$gt = \sinh(g\tau)$$

e.

$$u^x = \sinh(g\tau) = gt$$

$$u^t = \cosh(g\tau) = \sqrt{1 + \sinh(g\tau)^2} = \sqrt{1 + (gt)^2}$$

$$v_x = \tanh(g\tau) = \frac{gt}{\sqrt{1 + (gt)^2}}$$

References

[1] M.H. El-Deeb. PEU-453 Assignments.