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Minowski's Spacetime in Heterogeneous Medium FLORENTIN SMARANDACHE, University of New Mexico — Let's suppose that both locations $L_1(x_1, y_1, z_1)$ and $L_2(x_2, y_2, z_2)$ are under water, somewhere in the Pacific Ocean. Now light in the water has a smaller speed ($\mathrm{c_w}$) than in vacuum, i.e. $c_w < c$. Therefore within the same interval of time $t_2 - t_1$, light travels in the water a lesser distance than L_1L_2. Thus $d(E_1, E_2)$ has a different representation now L_1L. And, if instead of water we consider another liquid, then $d(E_1, E_2)$ would give another new result. Therefore, if we straightforwardly extend Minkowski's spacetime for an aquatic only medium, i.e. all locations $L_i(x_i, y_i, z_i)$ are under water, but we still refer to the light speed but in the water (c_w) then the coordinates of underwater events E_w would be $E_w(x_i, y_i, z_i, c_w, t_i)$ and Minkowski underwater distance would be:

$$d_w^2(E_{w1}, E_{w2}) = c_w^2(t_2 - t_1)^2 - [(x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2]$$

But if the underwater medium is completely dark it might be better to consider the speed of sound in order to communicate (similarly as submarines use sonar). Let's denote by $\mathrm{s_w}$ the underwater speed of sound. Then the underwater events $E_{ws}(x_i, y_i, z_i, s_w.t_i)$ with respect to the speed of sound has the Minkowski underwater distance:

$$d_{ws}^2(E_{ws1}, E_{ws2}) = s_w^2(t_2 - t_1)^2 - [(x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2]$$

Similarly for any medium M where all locations $L_i(x_i, y_i, z_i)$ are settled in, and for speed of any waves W that can travel from a location to another location in this medium.

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