# Re: Age Correspondences, When Both Travelers Accelerate

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I've finally finished my study of the "Quasi−Minkowski" procedure for determining the age correspondences for two travelers who each accelerate arbitrarily and independently. I suspected that the procedure might have advantages over the "direct" method which I have described in previous postings. But I have now concluded that that hope was ill−founded: it can't work.

The direct method
requires that we determine the intersection of the line of simultaneity (LOS) of the observer (say, T1) at some instant in T1's life, with the worldline L2 of the object (say, T2).
My hope was that the quasi−Minkowski (QM) method could eliminate the need for determining that intersection.

In the direct method, we select an inertial frame (called the FIRF, for "fixed inertial reference frame"), and plot the worldlines L1 and L2 with respect to this frame. Call the axes of the FIRF x0 and t0. We then use x0 for the vertical axis of the plot, and t0 for the horizontal axis (which is opposite from the usual convention). So on this diagram, we plot both L1 and L2.

At any instant t1p in T1's life, there is a "momentarily stationary inertial reference frame", the MSIRF1(t1p), for T1. (I.e., at the instant when t1 = t1p, there is an inertial frame in which T1 is momentarily stationary). Denote the coordinates for the MSIRF1 as mx1 and mt1.

Likewise, at any instant t2p in T2's life, there is an MSIRF2(t2p). Denote the coordinates for the MSIRF2 as mx2 and mt2.

For the instant t1p, we can plot the axes mx1 and mt1 on the (t0, x0) plane. The axis mt1 will make some angle alpha1 with the t0 axis (whose tangent is the speed beta1 of T1 wrt the FIRF). Positive alpha1 is counter−clockwise for positive beta1.

The axis mx1 will make the same angle alpha1 with the x0 axis (positive is clockwise). So the two axes mt1 and mx1, when plotted on the (t0, x0) plane, will be rotated by equal amounts toward an imaginary line at +45 degrees on the (t0, x0) plane (when beta1 > 0). For negative beta1, the positive mt1 axis is rotated below the positive t0 axis, and the positive mx1 axis is rotated by the same amount to the left of the positive x0 axis.

Likewise, we can plot the axes mt2 and mx2 on the same (t0, x0) plane, and the angles will in this case be equal to the tangent of beta2.

At t1 = t1p, the line of simultaneity for T1 is a straight line parallel to the m1x axis, and passing through the point on the worldline L1 where t1 = t1p. So, in the direct method, we need to determine the intersection of that line with the worldline L2.

Now, it is possible to perform a transformation, which rotates the mt1 axis to horizontal, and the mx1 axis to vertical. On this new (mt1, mx1) plane, the mx2 and mt2 axes will each be rotated by some new angle, alpha_new. This is the QM transformation, which has the desired property that the lines of simultaneity (t1 = t1p) are now vertical, and it is now trivial to determine their intersection with any other curve plotted on this new (mt1, mx1) plane. This is the basis of the QM method. I had hoped to perform this transformation, at each small step dt1, and thereby eliminate the need to determine the LOS intersection that is required in the direct method.

But the fallacy is this: before the transformation can be performed, both instants t1 = t1p and t2 = t2p in the lives of the travelers must be specified. Once that is done, then it is indeed true that the point on the worldline of T2 where t2 = t2p will indeed be vertically above the point on the horizontal axis where t1 = t1p. So the determination of the intersection is now trivial. But the "fly in the ointment" is that we have to already know the age of t2 which corresponds to the age t1 = t1p, BEFORE we can do the transformation! I.e., we actually have to KNOW the intersection in the direct method before we can perform the transformation. So the transformation is not of any value in avoiding the determination of the intersection.

This all seems very obvious to me now, but I've been dancing around this issue, without really understanding it, for about a month now.

So, the bottom line is that the direct method is (as far as I know) the only game in town. But that's not really so bad:

the program (called cado2) that I wrote to implement the direct method works fine, and runs fast enough to be practical to use. The algorithm I used to determine the intersection is just "brute−force" and unsophisticated, and not very efficient, but it apparently is fast enough.

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