Calculating the Frame Dragging effect using a Classical Physics Model

According to my theory [1], the space/medium field is an energy field comprised from the sum of the gravitational potentials of all masses in the Universe, with a total value of c^2 in empty space.

The Frame Dragging effect is due to a percentage of that total energy being set in motion. The inertia of objects in this energy field is determined by referenced to the state of motion of the field, thus if the field itself is set in motion, it affects the state of motion of objects within the field too.

Due to this effect on the inertia, there is a difference in the energy of an object in orbit around a large spinning body compared to its orbits around a large stationary body.

The amount of the angular speed imparted to a object that is in a circular orbit around a large spinning body (such as the Earth) depends on this energy difference.

Any object in a circular orbit will have Kinetic (KE) and Potential (PE) energies of the same magnitude as is always the case for an object in Uniform Circular Motion. This can be proved by modelling the circular motion of an object as two Simple Harmonic Oscillators perpendicular to one-another, each with energy cycling between fully Kinetic and fully Potential energies. At all times the total sum of KE and PE of both Simple Harmonic Oscillators is equal.

Thus, the total energy change for the orbiting object can be determined by calculating the proportion of the total Gravitational Potential Energy in the space occupied by the object that has been set in motion by the large spinning body, and then doubling it (because the total energy is KE + PE, and KE = PE for Uniform Circular Motion - so the total energy is 2*PE).

Using the principle of my model that the space/medium field is comprised of the sum of the gravitational potentials of all masses in the Universe, with a total value of c^2, the fraction of that total potential attributed to the rotating mass (the Earth) can be determined. The Gravitational Potential Energy attributed to the large rotating body (the Earth) is GM/r, so the amount or potential set in motion by its rotation is GM/r multiplied by the Angular Momentum [3] of the rotating mass (the Earth) at the orbital distance of the orbiting object. Then as previously discussed, the total energy change due to the rotation is twice that (KE + PE = 2*PE).

The following calculation first shows the amount of the Frame Dragging as calculated using the formula from Relativity [2] (which also includes the colatitude angle theta), then the equivalent (much simpler) calculation from the principles of my theoretical model, and finally the two results are compared and a percentage difference is calculated. Currently my calculation doesn't have a colatitude angle in the calculation so the resulting number would be for a location in the equatorial plane of the spinning large body (the Earth). The Relativistic calculation has been done for the two extreme locations of colatitude: At the Pole and the Equator. For the Earth there is very little difference in the resulting Frame Dragging between these locations.

restart;
Digits := 15;

$$r_s := \frac{2 \cdot G \cdot M}{c^2};$$

$$\alpha := \frac{J}{M \cdot c};$$

$$\rho_{squared} := r^2 + \alpha^2 \cdot \cos^2(\theta);$$

$$\Omega := \frac{r_s \cdot \alpha \cdot r \cdot c}{\rho_{squared} \cdot (r^2 + \alpha^2) + r_s \cdot \alpha^2 \cdot r \cdot \sin^2(\theta)};$$

simplify(Ω);

$$15$$

$$\frac{2\,G\,M}{c^2}$$

$$\frac{J}{M\,c}$$

$$r^2 + \frac{J^2 \cos(\theta)^2}{M^2\,c^2}$$

$$\frac{2\,G\,J\,r}{c^2 \left(\left(r^2 + \frac{J^2 \cos(\theta)^2}{M^2\,c^2}\right)\left(r^2 + \frac{J^2}{M^2\,c^2}\right) + \frac{2\,G\,J^2\,r \sin(\theta)^2}{M\,c^4} \right)}$$

$$-(2\,G\,J\,r\,c^2\,M^4) \Big/ \big(-J^2 \cos(\theta)^2\,r^2\,M^2\,c^2 - J^4 \cos(\theta)^2 - r^4\,M^4\,c^4 - r^2\,M^2\,c^2\,J^2 - 2\,G\,J^2\,r\,M^3 + 2\,G\,J^2\,r\,M^3 \cos(\theta)^2\big)$$

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$c := 299792458;$
$M := 5.972E24;$
$G := 6.67408E-11;$

$EarthRadius := 6371000;$
$OrbitalHeight := 100000;$

$r := EarthRadius + OrbitalHeight;$
$\omega := \frac{2\,\pi}{24 \cdot 60 \cdot 60};$
$Inertia := 0.4 \cdot M \cdot EarthRadius^2;$
$J := Inertia \cdot \omega;$

$\theta := 0;$

$RelativityDraggingColatitude1 := simplify(evalf(\Omega));$

$\theta := \frac{\pi}{2};$

$RelativityDraggingColatitude2 := simplify(evalf(\Omega));$

$DifferenceBetweenColatitudes := RelativityDraggingColatitude2$
$\quad - RelativityDraggingColatitude1;$

$$c := 299792458$$
$$M := 5.972\;10^{24}$$
$$G := 6.67408\;10^{-11}$$
$$EarthRadius := 6371000$$
$$OrbitalHeight := 100000$$
$$r := 6471000$$
$$\omega := \frac{1}{43200}\,\pi$$
$$Inertia := 9.69605344208000\;10^{37}$$
$$J := 2.24445681529630\;10^{33}\,\pi$$
$$\theta := 0$$
$$RelativityDraggingColatitude1 := 3.86479911349592\;10^{-14}$$
$$\theta := \frac{1}{2}\,\pi$$
$$RelativityDraggingColatitude2 := 3.86479911349735\;10^{-14}$$
$$DifferenceBetweenColatitudes := 1.43\;10^{-26}$$

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$$\phi := \frac{G \cdot M}{r};$$

$$phifraction := simplify\left(evalf\left(\frac{\phi}{c^2}\right)\right);$$

$$MyModelDragging := simplify\left(evalf\left(\frac{J}{M \cdot r^2} \cdot 2 \cdot phifraction\right)\right);$$

$$PercentageDifferenceBetweenModelsColatitude1 := simplify\left(evalf\left(100 \cdot \frac{MyModelDragging}{RelativityDraggingColatitude1}\right) - 100\right);$$

$$PercentageDifferenceBetweenModelsColatitude2 := simplify\left(evalf\left(100 \cdot \frac{MyModelDragging}{RelativityDraggingColatitude2}\right) - 100\right);$$

$$\phi := 6.159419836192224\ 10^{7}$$

$$phifraction := 6.85327882599706\ 10^{-10}$$

$$MyModelDragging := 3.86479911349880\ 10^{-14}$$

$$PercentageDifferenceBetweenModelsColatitude1 := 7.50000000000000\ 10^{-11}$$

$$PercentageDifferenceBetweenModelsColatitude2 := 3.80000000000000\ 10^{-11}$$

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From these calculations we can see that there is very little difference between the calculated Frame Dragging: 3.8E-11 in the Equatorial plane. To date the most accurate measurement of Frame Dragging that has been performed is only accurate to about 10%, so my calculated result is well within the margin for error and may even represent a more accurate answer than that given by Relativity. The analysis from my model is both simple and easy to understand unlike the complicated equation and explanation provided by Relativity.

References:

[1] Traill. Declan. “A Classical Reconstruction of Relativity”, 2012

http://vixra.org/abs/1507.0055

[2] Wikipedia "Frame-dragging"

https://en.wikipedia.org/wiki/Frame-dragging

last accessed 26/06/2019

[3] "Angular Momentum", Vanderbilt University

https://www.vanderbilt.edu/AnS/physics/astrocourses/ast201/angular_momentum.html

last accessed 26/06/2019