

Review of Newton's Bucket on Wiki

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Abstract

Newton's Bucket has been an enigma since being published in the Principia in 1687. It was the source of debate between Newton's absolute space and Ernst Mach's concept of relative rotation with respect to distant objects.

Wikipedia's rendition of the *Bucket argument* provides no solution but just confusion by ignoring some basic facts which will be pointed out in the detailed edits below.

- Relativity is assumed true instead of being proven true
 - Kinematics and dynamics are not distinguished
 - Arguing against discarded theories is pointless
 - Switching reference frames during observations is fatal
 - Missing the crucial role of the lab frame
 - Fictitious forces are symbols of fictitious physics.
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The key is to recognize that:

water at rest in the bucket frame => no rotation => no centrifugal force => no covariance
=> laws of dynamics are invalid in a non-lab frame.

Bucket argument

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From Wikipedia, the free encyclopedia

Isaac Newton's rotating bucket argument (also known as Newton's bucket) was designed to demonstrate that true rotational motion cannot be defined as the relative rotation of the body with respect to the immediately surrounding bodies., these experiments provide an operational definition of what is meant by "absolute rotation", and do not pretend to address the question of "rotation relative to *what?*"^[1]

MS certainly doesn't address absolute vs relative rotation in the NBX ...but the ALFA model analysis of NB surely does..

...General relativity dispenses with absolute space

..and analysis of NB with realistic logic , concluding that there is absolute rotation around Earth - dispenses with GR!

Background

Despite their embrace of the principle of rectilinear inertia and the recognition of the kinematical relativity of apparent motion (which underlies whether the Ptolemaic or the Copernican system is correct)....

The Ptolemaic system??? Discarded by Tycho Brahe 4 centuries ago and now the key kinematic model of the GeoC rebellion.... Talk about beating a dead horse ...or building a false strawman.

The argument

Newton discusses a bucket (Latin: *situla*) filled with water hung by a cord... as the cord continues to unwind, the surface of the water assumes a concave shape as it acquires the motion of the bucket spinning relative to the experimenter. This concave shape shows that the water is rotating,

in the lab frame....

despite the fact that the water is at rest relative to the pail.

This is the break with covariance...the law of physics – centrifugal force – is only obeyed in the lab frame, where the water IS rotating.

In other words, it is not the relative motion of the pail and water that causes concavity of the water, contrary to the idea that motions can only be relative, and that there is no absolute motion.

True...but incomplete.

Possibly the concavity of the water shows rotation relative to *something else*: say absolute space?

Or possibly relative to the laboratory??! ..say relative to the ECEF frame??

Wiki plays dumb to the obvious?

Newton says:

"One can find out and measure the true and absolute circular motion of the water".

Of course.... Isaac can measure it in his laboratory frame and make the right prediction using the CForce

.....relative motions...are altogether destitute of any real effect.

...if the laws of dynamics are not applied in the ECEF ref frame.

...It is indeed a matter of great difficulty to discover, and effectually to distinguish, the true motions of particular bodies from the apparent;

No difficulty at all... It's the Earth frame vs. non-Earth frames!

...because the parts of that immovable space in which these motions are performed, do by no means come under the observations of our senses.

Replace with:

the parts of that immovable reference frame in which these motions are performed, do ... come under the observations of our senses. i.e. the ground.

..... the concavity of the water clearly involves gravitational attraction, and by implication the Earth also is a participant.

Yes, the Earth defines the absolute frame of reference

Here is a critique due to Mach arguing that only relative motion is established:

Newton's experiment with the rotating vessel of water simply informs us that the relative rotation of the water with respect to the sides of the vessel produces no noticeable centrifugal forces, but that such forces are produced by its relative rotations with respect to the mass of the earth and other celestial bodies. — *Ernst Mach, as quoted by L. Bouquiaux in Leibniz, p. 104*

Replace with:

...the relative rotation of the water with respect to the sides of the vessel produces no noticeable centrifugal forces, but that such forces are produced by its absolute rotations with respect to the earth

All observers agree that the surface of rotating water is curved. However, the explanation of this curvature involves centrifugal force for all observers with the exception of a truly stationary observer,

This is not comprehensible... Curvature explanation is only possible for one stationary observer...in the lab frame, who finds the curvature is consistent with the rate of rotation of the water as he observes it. by using the laws of dynamics. No other frame predicts the CForce.

, with no need for an additional centrifugal force.

This smells like the 'fictitious force', that uses the lab frame value for CF when the laws of physics don't predict the observations...

Thus, a stationary frame can be identified, and it is not necessary to ask "Stationary with respect to what?":

The stationary frame has been identified...so why isn't the ECEF explicitly stated??

The original question, "relative to what frame of reference do the laws of motion hold?" is revealed to be wrongly posed. For the laws of motion essentially *determine* a class of reference frames, and (in principle) a procedure for constructing them,

No – the original question of covariance is perfectly posed. The laws of motion are determined by measurements in the class of all lab frames. The construction principle is simple – make observations in the lab frame!

The second sentence is deceptive...implying that we still need to look for covariant ref frames , when the NBX clearly identifies the stationary and absolute ref frame.

A supplementary thought experiment with the same objective of determining the occurrence of absolute rotation also was proposed by Newton: the example of observing two identical spheres in rotation about their center of gravity and tied together by a string. Occurrence of tension in the string is indicative of absolute rotation;

Yes, and the tension/CF must be measured in the earth frame, to be predicted.

Detailed analysis

Newton's laws of motion

..... The analysis begins with the free body diagram in the co-rotating frame where the water appears stationary.

The water is stationary, so the rate of rotation or angular velocity Ω is zero.

An element of water volume on the surface is shown to be subject to three forces: the vertical force due to gravity F_g , the horizontal, radially outward centrifugal force F_{cfl} , and the force normal to the surface of the water F_n due to the rest of the water surrounding the selected element of surface.

But $F_{cfl} = m\Omega^2 r = 0$ since $\Omega = 0$! There are only two forces, both vertical, not three.

.... (A very similar problem is the design of a banked turn, where the slope of the turn is set so a car will not slide off the road.

Really not similar, since the banked turn is designed in the earth frame, not a non-lab frame like the bucket.

As r increases, the centrifugal force increases according to the relation (the equations are written per unit unit mass):

$$F_c = m\Omega^2 r$$

where Ω is the constant rate of rotation of the water.

NO..... Ω is zero in the co-moving bucket frame!!!

Water is at rest in the bucket frame of reference.

Ω in the lab frame MUST be used....

From here on ... is without empirical or logical foundation.