Re: moment of inertia of a cube

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- *From*: Uncle Al <UncleAl0@xxxxxxxxxxxxx>
- *Date*: Sat, 31 Mar 2007 09:04:13 −0800

"John C. Polasek" wrote:

> On Fri, 30 Mar 2007 13:44:22 −0800, Uncle Al <UncleAl0@xxxxxxxxxxxxx>
> wrote:
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> > "John C. Polasek" wrote:
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> > > On 29 Mar 2007 22:05:37 −0700, bob@xxxxxxxxxxxxxx
> > > wrote:
> > >
> > > > I calculated today that the moment of inertia
> > > > of a cube does not
> > > > depend on the axis of rotation. Is there a real
> > > > intuitive way to see
> > > > this?
> > > >
> > > > Thank you.
> > >
> > > It would be interesting to see how you calculated that fact.
> > > But it is
> > > true and can be proved trivially.
> > >
> > > J is a 2d rank tensor for a cube J11=J22=J33 so we J is equal
> > > to the
> > > scalar j x the identity tensor I.
> > >
> > > The similarity transform for a 2d rank tensor T is A*TA
> > > where A and A* are cosine rotation matrices for angle a and
> > > −a. Thus
> > > for any rotation a about (any) axis (compound or principal is
> > > OK)
> > >
> > > J' = A*JA = A*IA = A*A= I = J
> > >
> > > Thus the rotations have no effect on the cube tensor.

John Polasek

> What about the right circular cylinder of height=(radius)[sqrt(3)]?
> Get funky!

> Same answer but fruitier: .5Ma^2 x Identity matrix. Who'd athunk it?
> John Polassek

We did, though not through the front door. Petitjean's quantitative geometric parity divergence normalized measure CHI depends upon a mass distribution's moments of inertia. If CHI−>1 that chiral distribution must have three identical, indistinguishable moments of inertia in all Eulerian angle orientations of the principle axis passing through the center of mass.

Right prisms also work. Take that cylinder, shave its sides into an orthogonal regular hexagon, and measure the radius "properly." All three moments of inertia are indistinguishable as long as the principle axis passes through the center of mass.

One cute thingie was finding classes of chiral mass distributions that met this criterion but had CHI−>0 with increasing radius. Uncle Al isn't telling.

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Uncle Al
http://www.mazepath.com/uncleal/
(Toxic URL! Unsafe for children and most mammals)
http://www.mazepath.com/uncleal/lajos.htm#a2
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