Subject: Re: Averaging quaternions
Posted by Arnold Neumaier on Sun, 21 Mar 2004 17:48:33 GMT
View Forum Message <> Reply to Message

jelansberry wrote:
> "Arnold Neumaier" <Arnold.Neumaier@univie.ac.at> wrote in message
> news:405D56B6.6030403@univie.ac.at...
>
>> jelansberry wrote:
>>
>>> I would compute the average of the
>>> Euler angles, and then convert the resulting average Euler angles back to a
>>> quaternion (convert the Euler angles to a direction cosine matrix, then
>>> extract the quaternion).
>>
>> This has exactly the same problems as averaging over quaternions, since
>> angles are only unique up to a multiple of pi or 2pi; so the average
>> depends on whether you represent an angle by a number close to pi or
>> close to -pi ...
>>
>> Arnold Neumaier
>>
>
>
> "Uniqueness" of the Euler angles is not the issue, it's more an issue of
> continuity of the angles. Euler angles do not have the "same" problems as
> averaging over quaternions. My basic beef with averaging quaternions is
> that the initial result of the average is not a quaternion (i.e., the result
> does not have unit norm). Euler angles do not suffer from such a
> complication.

The real part of a unit quaternion (with nonnegative real part)
is redundant in that it can be recomputed from the imaginary part.
Thus averaging the imaginary parts and recomputing the real part
would be a simpler recipe of the same kind as yours with Euler angles.
And it would have exactly the same problems as the avarage-and-scale
method, although there are no asingularities. It is a matter of
non-uniqueness in both cases, which implies that one must make ad hoc
normalizations: A choice of sign in the quaternion case, and a choice
of some normalization interval in the Euler case. This cannot be
done without introducing discontinuities - these are not present
in the mathematics but only in the normalization chosen.

> If all the OP is doing is trying to find the average attitude over some
> fairly small period of time, then one might expect the Euler angles
> corresponding to the quaternion samples to fairly continuous.

Not if one of the angle is just a little less than pi and increasing beyond pi (suddenly becoming -pi)

> I agree (and my post gave fair warning) that with Euler angles one has to be
> careful of choosing sequences near the singularity of the sequence.

AND near the normalization bounds! The average-and-scale technique is thus even better since it has no singularities and only the problem with possible discontinuities in the representation.

Arnold Neumaier