

## Re: GPSMAP 60Cx or 76Cx?

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  - *Date:* Wed, 07 Jun 2006 10:42:42 +0200
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Wolfgang S. Rupprecht wrote:

Terje Mathisen <[terje.mathisen@xxxxxxxxxxxxxx](mailto:terje.mathisen@xxxxxxxxxxxxxx)> writes:

Wolfgang, I agree. OTOH it is still one more decimal than any other external format Garmin have used previously. For my 76S WAAS/EGNOS/ESTB tests last year I had to write my own sw to download the semi-circle format binary values directly, having 10-cm level info directly available is *\_nearly\_* as good.

The semi-circles are nice aren't they? They roll around at automatically 360-degrees without having to explicitly clip them and they don't waste any bits by not having any huge unused bit patterns. I just wish someone would write a set of trig routines for them.

I'm almost certain you can find those, possibly even inside open source trig libs:

If you want to do trig "right", then you probably want to return exact (i.e. correctly rounded) results for all possible inputs: This requires you to do range reduction with a value for pi which is accurate to more than 1024 bits (which is the range of the exponent in IEEE double precision).

The only really good way to do this is by converting, at least temporarily, to semi-circles by multiplication by an array of values that add up to  $1/(2*\pi)$  (possibly scaled by a power of two).

Doing this will then convert the input to a floating point number where the fraction is identical to the Garmin trig format, and the integer part can be discarded. Using the top 3 fractional bits to determine the relevant octant of the circle, the remainder can then be used more or less directly in a Cheby polynomial to calculate sin/cos/tan. The scale factor to convert from semi-circles back to radians can instead be pulled into the individual polynomial terms. :-)

(BTW, there is one good reason for working in radians for sin/cos: It is possible to modify the normal Cheby poly to force the first term to be the same as for the Taylor series, i.e. 1.0, which makes it easier to achieve near-perfect accuracy.)