

# An open source geo-transformation library for data custodians.

Thomas Knudsen, Karsten Engsager, Knud Poder, Simon Lyngby Kokkendorff

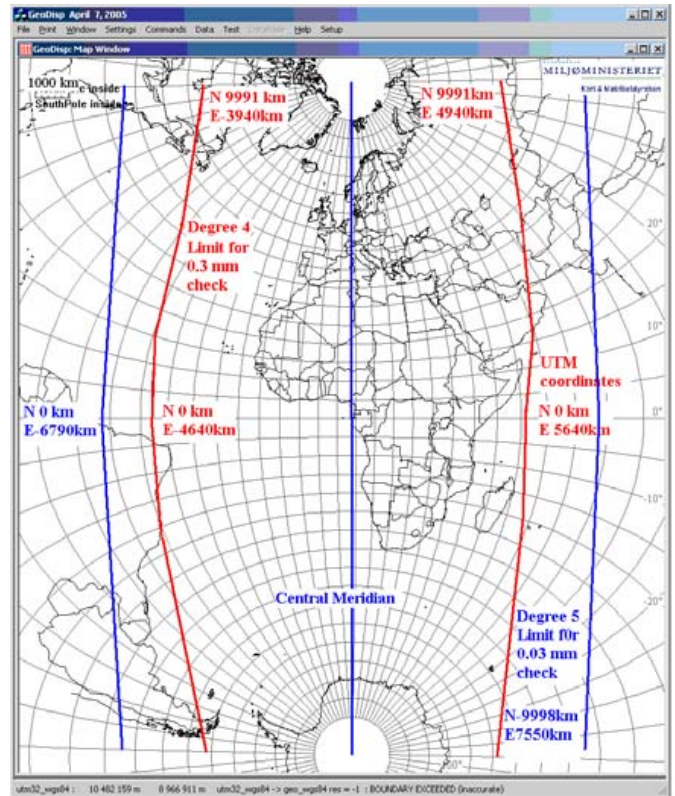
The KMStrlib geo-transformation library, which has been in active use and development since the 1960s at KMS (National Survey and Cadastre, Denmark), is now finally being released under an open source licence.

KMStrlib provides a unified interface to a large number of cartographic projections, and geophysical transformations (including change of vertical and horizontal datums and epochs).

Due to KMS's role as a long term geodata custodian, care has been taken to ensure that the transformations implemented are two way symmetric (to the extent possible: some transformations are inherently vaguely defined, and must be implemented by stochastic predictions, rather than projections).

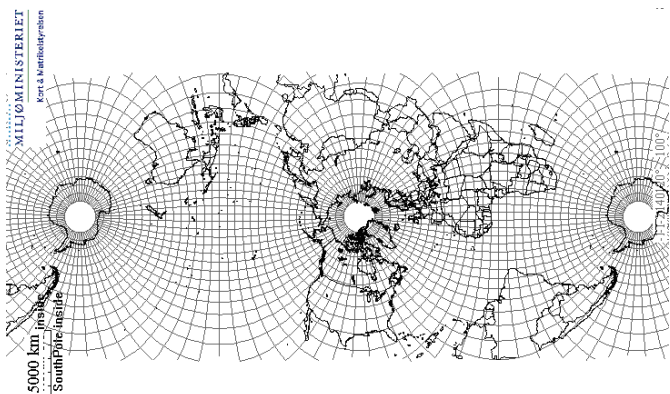
This has led to the adoption of a technique of dual self-checking transformations (outlined in the pseudocode below), effectively doing a roundtrip "forward-inverse" operation for all library calls.

While elaborate, this ensures that uncaught implementation blunders, and asymmetric singularities are diagnosed and reported. This is essential for long term (multiple century scale) geodata interoperability.



Great care has been taken, to eliminate loss of precision, leading to, e.g., the implementation of an *extended range transverse mercator* code, remaining accurate (and roundtrip-consistent) at the 0.03 mm level, even at distances 7500 km from the central meridian (figure above).

<pre> i      = (direct &gt; 0 ? 1 : -1); s      = -i; h      = -i -i; Cn = N; Ce = E;  for ( ; (h - i); i += s) {   switch(i) {     case 1: /* UTM -&gt; GEO */ </pre>	<pre> Cn = ... Ce = ... break; case -1: /* GEO -&gt; UTM */   Cn = ...   Ce = ...   break; case 0: /* transfer results */   *Nout = Cn; </pre>	<pre>       *Eout = Ce;       break;     }   }   /* tolerance test */   dCn = Cn - N;   dCe = Ce - E;   ... </pre>
--	--	--



The figure to the left shows how the extended range transverse mercator implementation may even be (mis)used to produce (almost) global maps, while remaining consistent and accurate. Such unorthodox tricks may actually prove useful in rare cases. It is, however, included here primarily as a curiosity.



DANISH MINISTRY OF THE ENVIRONMENT  
National Survey and Cadastre