The MRU and the SRF aligned
(The History of the Dutch Method)

In 1982 an article by ir. J.J. Knol was published in *Schip en Werf* (Ship and Warf) bearing the title "*Maatvoering aan onder helling opgestelde objekten en op drijvende platforms*" (Measurements of oblique placed objects and floating platforms). The article explained how to deal with 3D measurements when the coordinate system of the object was not aligned with the local vertical or even subjected to movement. Equipment used were a levelling instrument and a theodolite.

It was around this time that the Delta works at the Eastern Scheldt came to the phase that the pylons were placed. All vessels (Cardium, Macoma, Ostrea and the TL4) used in the operations and the pylons themselves had their geometry surveyed, probably based on the method described by Knol. The vessels were surveyed by the main contractor DosBouw, while the pylons were measured by a combination of DosBouw and the Survey Department of the Directorate-General of Public Works and Water Management (Rijkswaterstaat).

Since then Rijkswaterstaat started measuring survey vessels in this way, first the mv. Scholekster (by F. Maas and trainee H. van der Marel), then the mv. Houtvliet (by H. Murre and an assistant). The mv. Houtvliet was using centimetre accurate Minilir positioning and a 2 degree single beam transducer on a stabilised platform, controlled by a Newmark motion sensor. The method used to align the MRU to the SRF of the mv. Houtvliet consisted of pitch and roll calibration only. The rotation along the vertical axis was determined on sight. Measurements were done by theodolite, levelling instrument and tape measure.

In 1988 A.P.M. Pieters (who was already involved in the Eastern Scheldt works) took over the geometry measurements and calibrations of the mv. Houtvliet from Murre. Initially he continued where Murre stopped, but in 1989 he surveyed a new vessel (the mv. Christian Brunings) together with P. Kaslander. This was the first vessel within Rijkswaterstaat with a multibeam installed (EM100). In the meanwhile a total station had taken the place of the theodolite. From 1992 onwards multibeams were more widely installed (within and outside Rijkswaterstaat) resulting in a greater need for accurate geometry measurements, a great deal of which were done by Pieters.

In 1996 the department where Pieters worked attracted four new employees, among which P. van Waalwijk and the author. When Pieters left the department in 1998 his ten years of expertise in vessel measurements (I was able to trace 65 different vessels measured by him) had to be taken over by his colleagues, which was done by E.B. Wiegmann (who still is employed by Rijkswaterstaat) and the author. Together we not only mastered Pieters technique, but also incorporated it into a network adjustment package, allowing least squares adjustment of the measurements with forthcoming quality figures and even higher accuracies (2-3 millimetres).

In the meanwhile both Van Waalwijk and the author were running projects that had a common troublesome feature: the (mis)alignment of the MRU's vertical axis (for further

details see: N. de Hilster, *Second Benelux Tunnel, Shadow Immersion Survey System, Hydro International*, Volume 4, Number 6, 2000, pp. 66-69). The two projects, combined with ongoing vessel geometry measurements led to a method of aligning the MRU's vertical axis on board of floating objects like survey vessels.

I left Rijkswaterstaat by the end of 2000 and started my own business in which I developed a new way of vessel geometry measurements based on photogrammetry. I now use a digital camera is instead of a total station for the measurements. The advantage of this method is that it has better quality control (what you see is what you get), it is not affected by movement (simplifying surveys of floating vessels), it allows to measure points afterwards and requires less time. Additionally (sub)millimetre accuracies are achievable. In September 2004 the WESP, a 14 metres high vehicle for coastal zone surveys, was the first object subjected to this method officially (before that I tested the method on the Rijkswaterstaat vessel mv. Breesem). The method was accepted and gradually the number of vessels surveyed using this method increased. A total station is still used for vessels in dry docks and when they are larger than 50 metres.

Figure 1: The WESP being measured using photogrammetry (picture by A.P.M. Pieters)

In the meanwhile the number of vessels undergoing geometry measurements and calibrations using the Dutch method has gone up from a few per year in the 1980's to one every two weeks on average for last year.