General Lighthouse Authorities of the UK and Ireland

Development Department

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Loran Coverage Round Ireland

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Abstract

A Loran-C receiver and Differential GPS receiver were set up to log readings automatically on a computer and installed on the Irish Lights Tender Granuaille (II). The vessel made a circuit of Ireland carrying out maintenance work and this report contains the trackplots provided by the Loran-C/DGPS equipment. The Loran-C results, using the 7499 Sylt chain, were good round the East, South and North coasts, but showed some cycle slips and larger errors on the West coast. DGPS results, using automatic station selection, were continuous.

Introduction

Ireland is a member of the Northwest European Loran System, but because of political difficulties has not been able to establish the planned station on the West coast. The UK has observer status with NELS and is negotiating to join. Therefore the General Lighthouse Authorities of the UK & Ireland have an interest in knowing the present coverage of NELS, without the Irish station. The results reported here were obtained as part of a continuing programme of coverage monitoring round the UK & Ireland.

Method

A Locus LRS II Loran receiver and a Trimble NT200D DGPS receiver were set up to record positions automatically on a notebook PC. The equipment was installed on Irish Lights Buoy Tender Granuaille (II) in August 1999 at Dun Laoghaire (Figure 1). The vessel then carried out maintenance work for the next two weeks, making a complete circuit of Ireland.

Results

When the results were analysed, a time-tagging problem was found between the DGPS and Loran data. This caused large offsets between the tracks at times, not reflecting the true peformance of the systems. This problem was referred to Industrial Development Bangor, the commercial arm of the University of Wales, which has considerable experience in this area.
IDB reprocessed the data to eliminate the time-tagging problem and the track plots presented here show the results obtained. The DGPS track is in red and the Loran track in blue, with the coastline in green.

Figure 2 shows the track from Dublin Bay to Belfast Lough, Figure 3 from Belfast to Dundalk and Figure 4 from Dundalk back to Dun Laoghaire. All show continuous fixing with both systems and reasonably good agreement, except between the entrances to Strangford Lough and Belfast Lough where the difference increased to about 0.5 miles.
The vessel then headed south from Dun Laoghaire to Dunmore, Figures 5 & 6, attending the Arklow Lanby on the way. Again there was no loss of service and the maximum difference between systems was about .25 miles. From Dunmore to Schull, Figure 7, coverage was continuous, but after Galley Head a cycle slip occurred, resulting in an error of about 10 miles.
The vessel then proceeded to Crookhaven and the Fastnet before continuing round Mizen Head and up to Samphire Island, Figure 8. The Loran remained unreliable until North of Mizen Head when the cycle slip disappeared. From Samphire Island the ship went up the Shannon estuary, attending buoys on the way, Figure 9. The Loran signal was held, with an error of about 0.5 miles until after the Shannon ferry, when a cycle slip occurred. On the return passage the cycle slip persisted until Loop Head, Figure 10.
The error on the leg to Liscannor Bay was about 0.5 mile. From Liscannor Bay to Galway the error rose to about 0.75 mile, Fig 11. From Galway to Slyne Head the error was much smaller, but then a further cycle slip occurred, producing an offset of 18 miles, Figure 12. This cycle slip recurred up to Blacksod Bay, Figure 13. From Blacksod round to Killala Bay, Figure 14, there was a further cycle slip off the Mullet Peninsula, but the position remained good after that, although accuracy deteriorated to about 0.5 mile in the bay.
On the leg to Sligo Bay the position was good, but sailing north towards Donegal the error increased to around 0.5 mile, Figure 15. From Donegal round the north coast to Larne there were no cycle slips and the error remained at less than 0.25 mile for most of the passage, Figure 16. From Larne the vessel sailed to Dundalk, then back up to Strangford Lough before returning to Dun Laoghaire, Figure 17. Again there were no cycle slips and the error remained at about 0.25 mile for most of the way, increasing to 0.5 mile between Belfast and Strangford Loughs.

Discussion

The Loran signals were quite reliable round the North, East and South coasts of Ireland, but there were intermittent cycle slips on the West coast. Errors were generally 0.25 to 0.5 miles, with some higher figures on the West coast. The Locus LRS II is a good quality monitoring receiver, but does not employ the most up to date technology. The results are therefore probably no better than could be achieved with a modern navigation receiver using digital signal processing. A skilled operator would be able to detect and correct the cycle slips and again modern processing might cope with these automatically. The errors are of a magnitude and consistency to be expected with the significant landpaths between transmitters and receivers. These could be removed with appropriate corrections (Additional Secondary Factors). The situation would, of course, be greatly improved with a station on the West coast of Ireland.
An inspection of the DGPS data showed that the receiver provided good positions 100% of the time.

Conclusions

1. The Loran system is usable on the North, East and South coasts of Ireland.

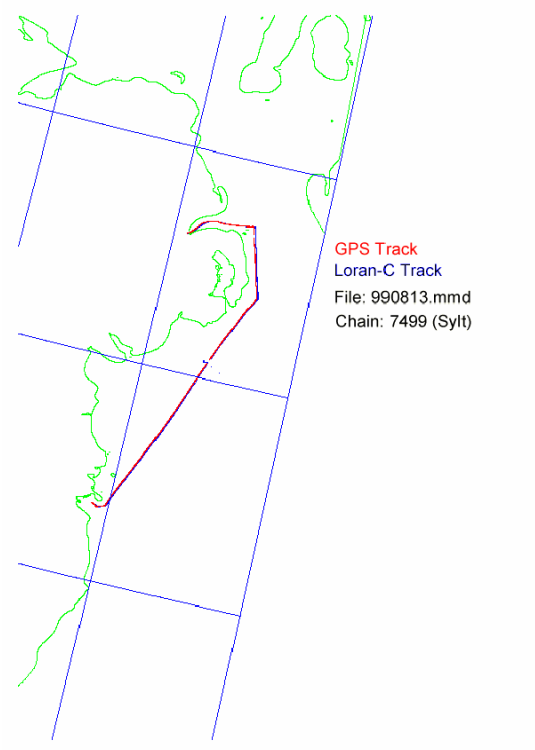
2. The system is unreliable off the West coast.

3. ASF corrections are necessary to obtain good accuracies.

Further Work

Data has also been collected round the south and southwest coasts of England and off South Wales and this will be analysed using the IDB developed software. Coverage results collected on board MV Pharos for the coast of Scotland have been summarised in conference papers (Annual Technical Symposium of the International Loran Association, 1996 & 1998), but further analysis using the IDB software may be productive.
The measurement system has been reassembled, using a more modern Locus receiver (Satmate), eliminating the time-tagging problem and incorporating a commercially available navigation receiver (Furuno LC90). The system has been placed on board another GLA tender to complete the coverage assessment.

Figure 1. Antenna installation on ILT Granuaille



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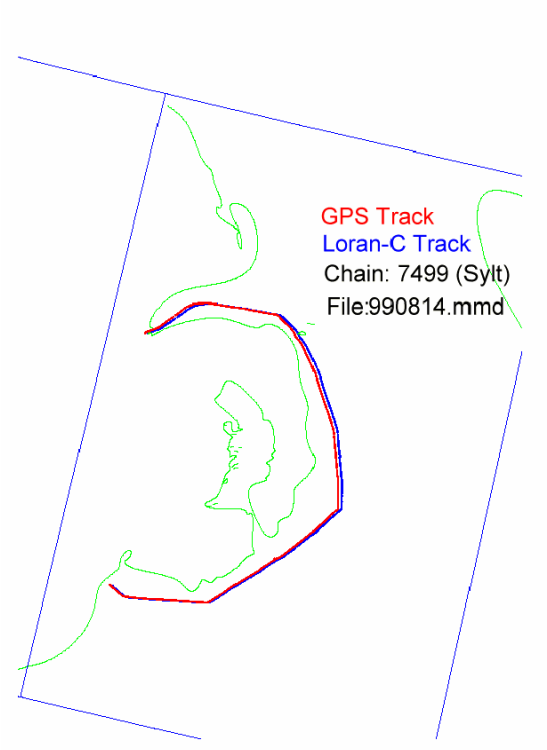
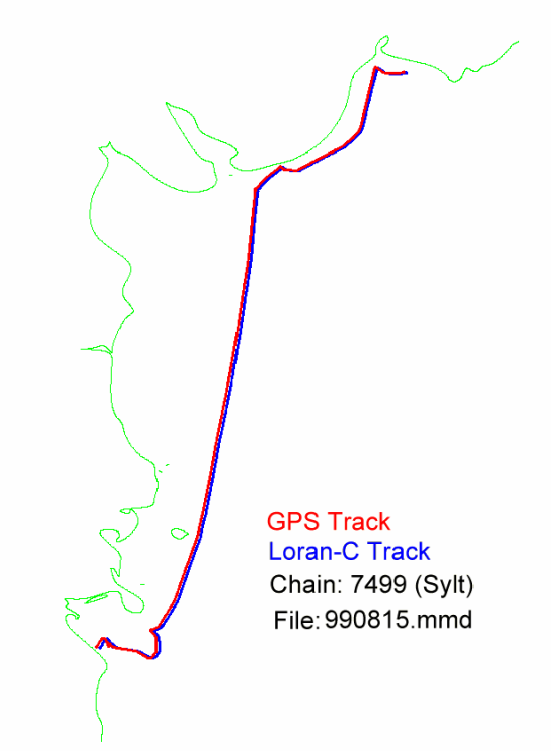


Figure 3



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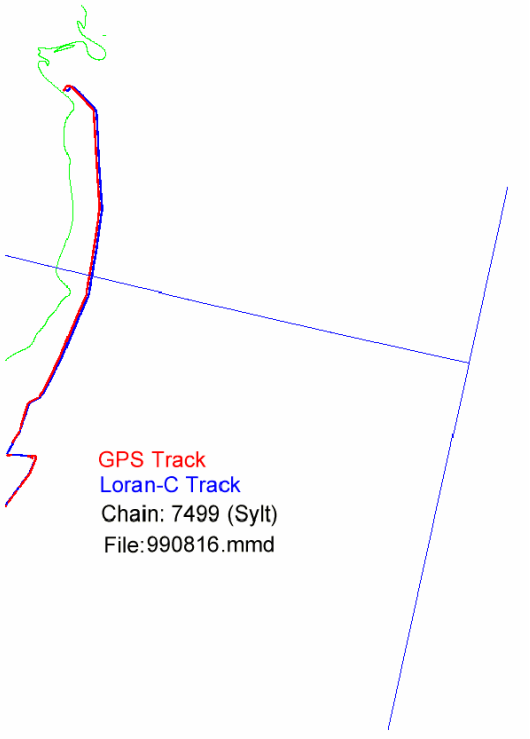


Figure 5

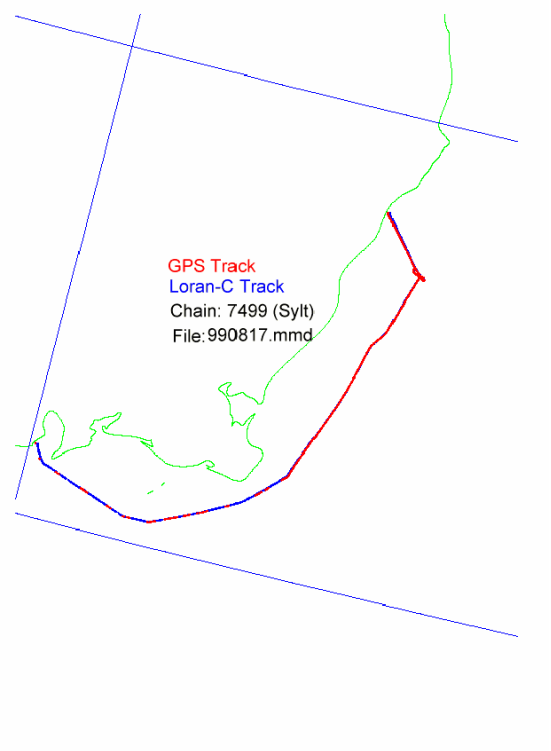
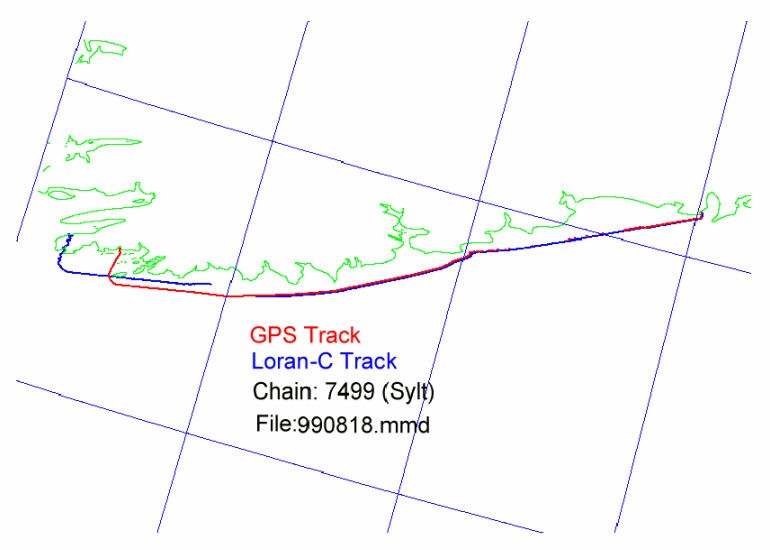


Figure 6



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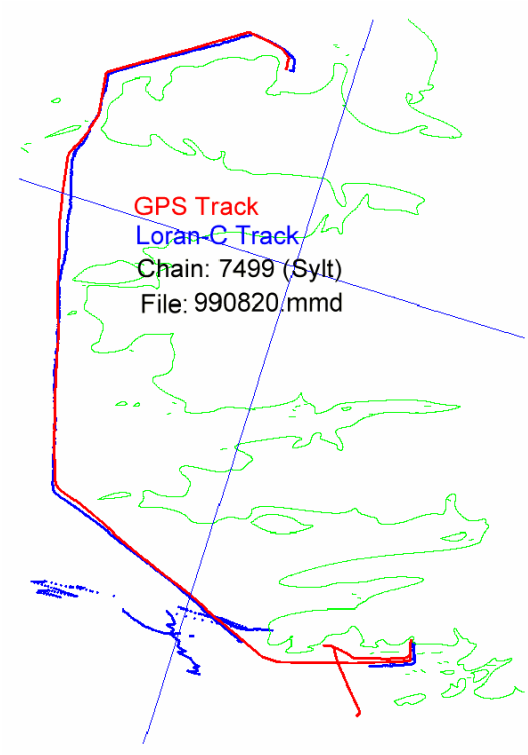


Figure 8

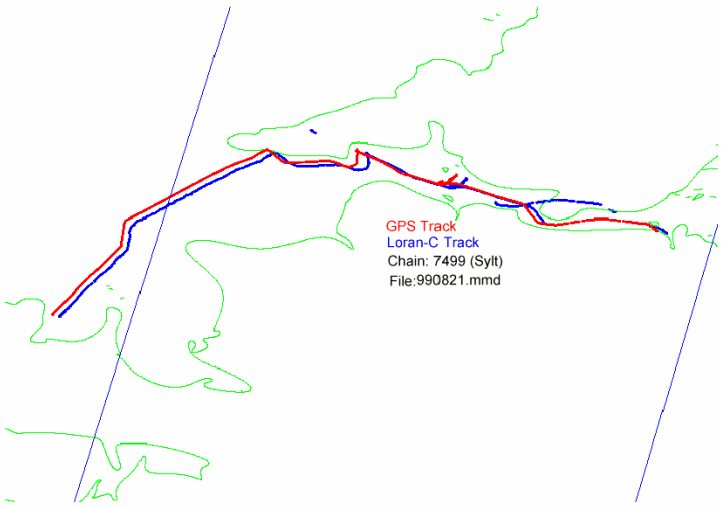
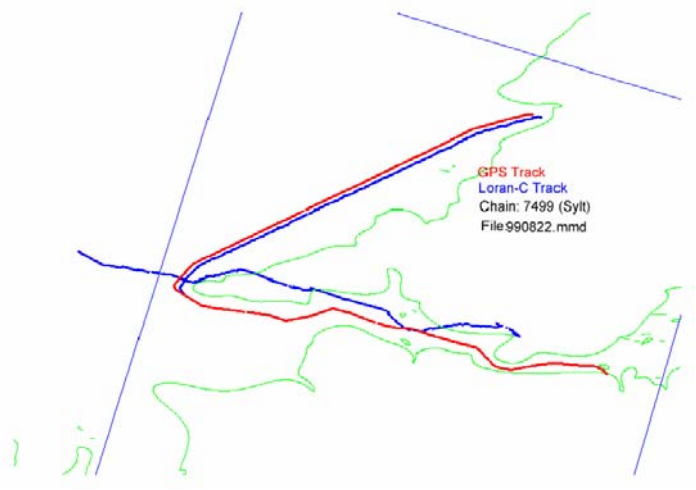


Figure 9



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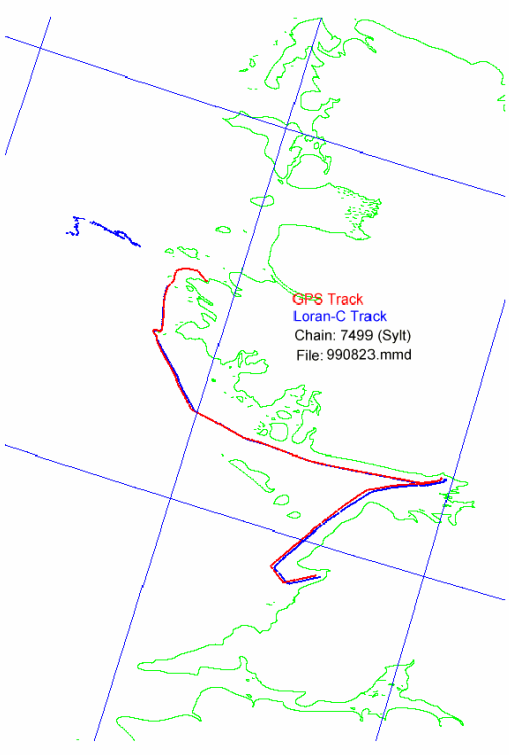

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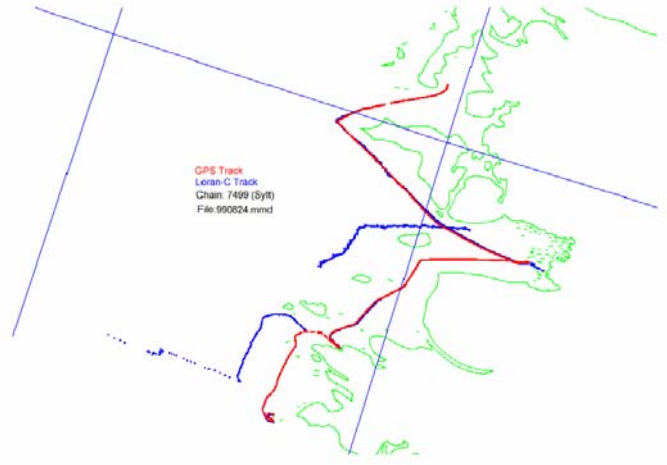
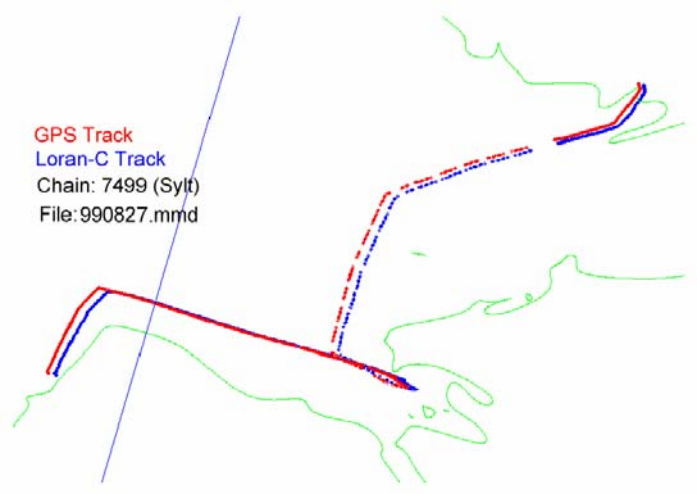


Figure 12

Figure 13



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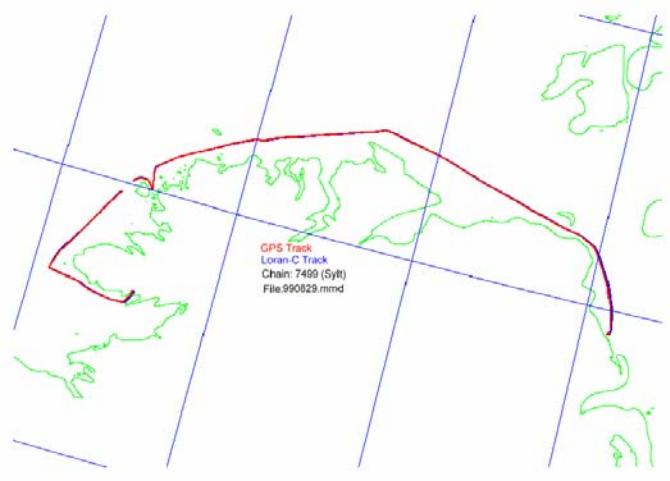

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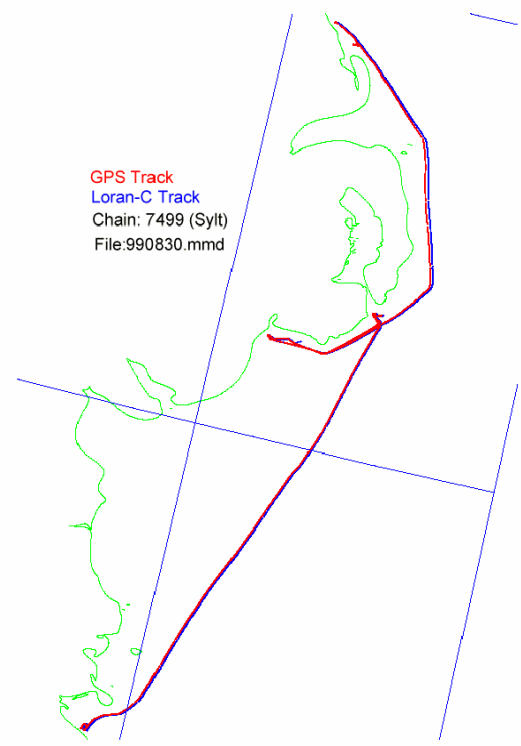

Figure 16