

## **GPS FOR MARINE NAVIGATION**

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### **I. INTRODUCTION**

Seafaring has always been an occupation which exposes the seafarer to more than an ordinary degree of risk, and a significant part of that risk arises from his inability always to know his position with sufficient accuracy, as and when needed. This lack of precision has always had a fundamental impact on the practice of navigation, the development of navigational aids, the production of charts, and so forth, and to a much greater degree than is, perhaps, generally realized. As we are now approaching the time when a global capacity to fix position on demand, and to a high degree of accuracy, is becoming available, it seems sensible that we should go back to first principles before forming a view as to its likely impact on future navigational practice.

There is, however, a major problem. So far as commercial users are concerned, it is understood that the accuracy of GPS as developed for military purposes is to be degraded by at least an order of magnitude. It would seem to be the assumption that this degraded accuracy is still of sufficient interest to commercial shipping to stimulate demand for the system. This assumption needs to be tested, since we are talking of a commercially available accuracy not greatly superior to that of Satnav (while it is still in service) so that the advantage of GPS would lie mainly in the availability of position on demand. It would thus not offer a great advantage over Satnav or Omega in the ocean and would not be good enough to displace Loran or Decca in those areas inshore where adequate cover already exists. As a commercial navaid GPS would fall, therefore, in the 'interesting' category, but it would by no means be good enough to become an essential fitting for very many vessels. If this should be the case, then its impact on

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commercial marine navigation will not be great, certainly in the short term, and no more need be said at this time.

Fortunately, it is arguable that, despite the declared intention to down-grade the system, the full capacity of GPS will become available to non-military users in the not too distant future. There are two rather different reasons for believing this will be so. The first is that the commercial value of a high-accuracy global positioning system is so immense, and in many applications besides marine navigation, that it is inconceivable that non-military access can be denied indefinitely. The second depends on the view that history will repeat itself as demonstrated by the fact that 'secret weapons' such as radar and jet engines quickly developed into the commercial market place.

## 2. THE EVOLUTION OF PRESENT-DAY NAVIGATION SYSTEMS

Man's ability to navigate on the sea and out of sight of land has depended on some knowledge of direction travelled. Associated with this has been the need to determine the position of places to be visited and hazards to be avoided. In time, as compasses and charts were developed and competence improved, very substantial voyages became possible. However, even today, and with the sophisticated systems at our disposal, our approach to navigation is still fundamentally based on the probability that there will be occasions when we will not know where we are with sufficient accuracy to avoid running into danger. This uncertainty has led to the duplication of systems, the provision of independent means of fixing position, a dependence on a comprehensive system of visual marks, and so forth. In addition we depend upon the navigational chart based upon meticulous surveys and presenting comprehensive information regarded by the seaman as essential to the safety of his vessel.

It has also been reflected in the training and the certification of navigators, where great emphasis is still placed on basic skills not greatly different from those practised a century or more ago. The fact that navigators are constantly reminded that what they have at their disposal are only aids to navigation reinforces the concept of doubt and the need to be on guard for errors or inaccuracies which increase risk and which may occasionally lead to an accident.

## 3. THE IMPACT OF GPS

The accuracy of GPS is such that it would satisfy the positional needs of commercial shipping for all purposes up to the final approach and docking operations, which are normally conducted visually. Although it would not provide heading it could provide instantaneous velocity and information on courses and speeds made good. If we may assume that the GPS equipment can be obtained at reasonable cost and that the system will be reliable, the basic navigational outfit

need comprise only the GPS receiver, a compass and the relevant charts. The consequences of this would be far-reaching, and some of the more significant will bear close examination.

### **Training and qualifications**

It is arguable that access to GPS will demand of the navigator only that he understands the system and has a general background knowledge of navigational theory. The major part of the current examination syllabus could be dispensed with. The specialist navigating officer could disappear, and the general-purpose officer able to undertake a much wider range of responsibilities would become a possibility.

### **Supplementary nav aids**

Few, if any, of the nav aids presently available would be required. Indeed, had GPS always been available, there would have been no requirement to invent them. The current range extends through radio systems, sextants and other on-board equipment to lighthouses, buoys, racons and so forth. Some of these items might still be required for vessels not wishing to use the GPS system but the scale on which they would be provided, and mechanism for financing their provision, would have to be reviewed.

### **Charts**

Much can, and should, be said about charts. They have two quite different functions. One is to provide information on the sea-bed comparable to the terrestrial information contained in maps. This is of interest to a wide body of users. The second is to display to the mariner the detail he needs to navigate effectively and to avoid danger. Up to now the mariner has required comprehensive information about the seabed because he will sometimes find himself in places where he would not wish to be. The accuracy of charts varies, many data are in use and (probably) the GPS datum coincides with none. Many areas of the world have not been adequately surveyed. Hydrographers internationally are cooperating to produce an international series of charts, a project which will take decades to complete. Since they are standardizing what already exists, it is questionable, in the light of the potential impact of GPS, whether it will be in the format required by the navigator when the project is completed. Because the GPS user will always know where he is, his interest will mainly be confined to the tracks along which he needs to navigate. This will have an important impact on future surveys, since survey work to satisfy the commercial navigational requirement will be much less extensive, and therefore much less costly, than has traditionally been the case. Indeed, a format more akin to that used in aeronautical charts may well serve his needs.

#### 4. NAVIGATION MANAGEMENT

Automatic navigation would seem to be a logical and practical element of a GPS navigation system, and the trend will inevitably be towards greater use of electronic techniques to gather and to display information. This will have an impact on bridge design and will add impetus to the concept of a much smaller command station at which the officer of the watch will be able to exercise full control over navigation, manœuvring and communications. A great deal of thought has been given in recent years to navigation management in the context of collision avoidance, traffic control and distress. The subject has generated much interest and a great deal of controversy, and these are matters which will not be resolved quickly. However, once GPS is in general use, impetus will be given to schemes to track the movement of vessels globally by making use of satellite communication systems. The capacity of such systems to transmit data will be such that it would be feasible to track a vessel's movements, to use this information to detect accidents and to provide assistance, and even, perhaps, to provide local ship position information which would be valuable for collision avoidance.

It is arguable that GPS is not an evolutionary development but a major advance which will radically alter the manner in which navigation is practised. This paper has commented on some of the possibilities should the full system capability become generally available. It is appropriate that debate is now being generated, and this is necessary if the changes which must follow its introduction are to be managed to best advantage.