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On chart making for PC / GPS navigation in small yachts and related topics.

Introduction

Modern commercially manufactured digital maps mostly give the highest precision and best looking appearance because they are made from a clean original database information and manufactured in one piece from the beginning. The chart files load quickly. As they have strictly single coloured areas they compress well and occupy a small disk space for their performance. Such charts may however not be available for the area or in the scale of your highest interest.

Recent programming development has however made it more efficient and attractive (if you enjoy such a type of hobby) to home scan your own paper charts for personal use with a "Free Ware" navigation program as SeaClear II (Olle Söderholm, SPING). They now will perform well even on a limited performance PC or Lap Top.

One remaining general problem is the poor visibility in bright sunshine of a standard Lap Top screen. It has to be well shadowed in a similar way as old RADAR screens . Use a TFT-screen when available. Even the reflexes from the navigators white shirt may often "white out" the screen if not well shadowed. During severe conditions try to cover the opening of the shadowing cover (home made and painted matt black inside) by your own face.

Development

I remember the history from the late 90-ies, when I first got interested, roughly like follows. The technique for "Free or Share Ware" GPS/PC plotting programs (SeaClear and others) was first to use a digital raster chart in BMP format which loaded quickly but occupied a large disk space. Reduction of dpi and colours was needed. Later the plotting programs were modified to support the compressed PNG (and others) format. Then the time to decompress and transfer the information to the fast RAM memory became the bottle neck. When loading the first chart there was a delay and for shifting to the next chart even sometimes a screen "black out" when using a low performance computer. More memory was the solution. Memory for laptops of that generation was and is still fairly expensive if available to day. Once loaded in the fast RAM these maps could be panned and zoomed quickly.

The new technique now available is called **"Disk Mapping"** or **"Paging from Disk".** For each new update of the computer screen only the visible part of the chart is read directly from the hard disk (or a CD, slower). This works very well in practice as the RAM size is not important. The delay to load a new chart is negligible. The present commercial raster charts type BSB/KAP format and others work this way and are also supported by the new SeaClear II version.

To utilise this new technique you have to convert your scanned BMP or PNG charts to a native compressed chart format called WCI which is working with disk mapping.

The tool to do this you find in the new SeaClear II.

According to the SeaClear II Manual huge WCI charts can be used on low performance computers. Up to 150 MB chart files are said to have been successfully tested.

According to some of my own few tests, PNG however still compresses a little bit better than WCI regarding disk space occupied.

The new SeaClear II is said to be completely rewritten and the charts can now be calibrated (giving a georeference in Long / Lat to the map) with many reference points. This is very essential as home scanned maps become more or less out of straight, skew and non square, compared to professional charts which are made in one piece. The old SeaClear I version worked with only two diagonally wide spaced calibration points per map (not too bad anyhow, I used it nicely for years).

Old digital home made raster maps can be imported and recalibrated with more reference points and used with a better accuracy in the new SeaClear II and the result can be checked in relation to an overlay grid.

Practical home scanning with a low price A4 flat bed scanner

General

As home made digital raster maps normally are made up of many stitched partial A4 images the grid of the final chart often becomes slightly out of straight, skewed and non square etc (the partial images become during the scanning process due to different reasons rotated in relation to each other with an angle of some decimals of

a degree). When calibrating with only two points the position accuracy may become less good, at least at some regions of the map.

Now with the ability to use many calibration points this drawback becomes less important as a deformed grid can be compensated to a large extent. Some basic scanning and stitching technique can anyhow be of interest.

Basic

Normally the smallest paper chart size used by local yachtsmen is of the size **A2**. Such a chart has to be scanned in four separate **A4** parts with overlap and stitched together by the use of a computer program as **CCS** (from SPING), some part of the chart border area has to be abandoned for the overlap. Larger charts have to be scanned in still more parts with overlap and stitched.

The flat bed of the scanner

Normally only A4 size scanners are available at a reasonable price for private people, of the order of $ 100:- for a standard new one. If you have a professional A3 scanner at your office you are lucky and the job will be reduced a lot.

If you have a limited expectation of your digital maps, just go ahead, scan and stitch. If you want to improve your result, please first read some of my following personal practical experience.

The active "glass area" for scanning with **simple** scanners is normally surrounded by an elevated border (1 – 2.5 mm) to align (and to keep the glass plate secured) the paper to be scanned. When an oversize paper map is scanned the parts positioned near and over these elevated walls will be distorted and discoloured. When this happens, this area has to be cropped away before stitching for a clean final result. This means that an A2 paper chart sometimes may not be fully covered by four A4 partial images without cropping off the whole boarder area with scales (neat line) and other interesting information. This could be a problem.

There are two main types of popular flat bed scanner designs. The traditional type is that the glass plate is a part of the upper plastic structure of the scanner and the box has to be opened from the bottom.

To minimise the distorting influence from the elevated edges of the glass, these can be machined down a bit by careful use of a wood working power tool, type "hand

router". This operation is a difficult one as the plastic has a tendency to melt in the heat generated. There is also a risk to crack the glass plate. This method also only to a certain degree reduces the image distortion.
If you like you can try to build your own new "upper box" with the glass flush on the top and place on the main bottom plate. The problem may be to get the glass exactly on the right height and parallel with the bottom for a good optical focus when scanning.

The other scanner design can be opened from the top and the glass plate is in practice the lid of the scanner box. The elevated border edges which are also the fixing means for the glass plate may in some cases be attached by double sided adhesive tape and can carefully be removed (Canon) . Then you have a scanner without elevated boarders and the paper map can leave the glass without distortion (most professional scanners I have seen are of this type and the elevation of the edges may be very low). Now you have to arrange new guiding means to align the paper chart properly. Use your fantasy and practical resources in a clever way for the new guiding means.

If you open your scanner for modification you will find under the glass area at each small end a tape or similar, one half side black, the other white. These are the optical reference marks for telling where to start and stop the full scanning motion and to calibrate the transmission: Step motor – Tooth belt – Scanning carriage. If you take away these your scanner will malfunction !!

The scanner may be installed, recessed, in a rectangular cut out in a bigger wooden board with the glass approximately flush to allow easy practical handling of bigger paper maps.

Setting the colour density of the image for best readability

Choose a scanner with a scanning soft ware allowing full control of the image scanning parameters to influence the image quality regarding dpi (resolution) and colour density / contrast. Automatic mode or "simple setting" results in bleak "washed out" charts that can not be read properly in "zoom out" for getting an overview of the navigation area. This may not be applicable for navigation programs which them selves automatically create zoomed out (for instance 25% and 50% chart versions) and save in the "chart folder" to be loaded on zoom demand.

According to my personal experience the “gamma” parameter (once created to compensate for the non linear characteristics of computer screens to reproduce colour intensity) can be very useful for chart making. Automatic or “simple mode” may set gamma to about 2.2 or something close. Try gamma: 1.5 – 0.5 and see what will result. In 100 % zoom, the colours of images with a too low gamma may look terribly sharp and hard, but then check in zoom 10 – 50 %. Gamma = 1 will give a linear transformation. Choose final gamma setting as a compromise for desirable best zoom in and zoom out reading of the map.

Different paper chart samples as well as different partial images of the same map may need their own colour density settings (much dark land or much white water). Too low a gamma will result in that clean white water areas may look “dirty”, particularly for old used paper charts. You may have to accept that the partial images will get slightly different colours in the final “stitched” map. This due to your own settings or that WINDOWS itself sometimes change the “colour palette” during processing (can not be prevented as much I know). Good luck, you soon will find your own preferences.

Remember that a paper chart once scanned with too little information (low dpi, bleak appearance, washed out colours or pore contrast) can never be restored to the quality of the original by any image processing program, the information is non existing. It may be more easy to erase information and fade it out by processing.

Scan with 100 – 250 dpi for an acceptable resolution. Earlier when only BMP format could be used it was necessary to use a low dpi value and save the images in 16 colours to reduce disk space. To day with the possibility to work with compressed file formats 256 colours is recommended.

Aligning the paper chart when scanning the different shots of the chart

Before starting to scan your charts make sure how the plotting program you intend to use handles maps with a skew or deformed grid (read program manual and test practically). This influences the amount of work you have to do with your new maps. A plotting program working with many reference points can compensate to a large extent for a bent grid and you do not have to “over do” the practical scanning process and the paper chart handling.

The edges of the paper chart are seldom quite parallel to the Lat / Long grid of the chart. Therefore for best result, guide or align from the same paper edge during the whole procedure (to make one complete chart) and avoid to rotate the paper during

all the partial image scannings. You may have to take away the standard folding cover of the scanner to handle the paper chart. When using SeaClear I / II it is not so important to get the map totally free of skew but to get the same skew over the whole map (the over lay reference grid could be skewed itself for compensation already in SeaClear I). Some early plotting programs works with the principle that the Long / Lat grid was scanned or rotated to be perfectly "horizontal / vertical".

Using the standard folding cover of the scanner and then rotating the paper chart around in different directions and finally electronically rotate the different parts back (90 or 180 degree steps) before stitching them together will almost always result in a final chart with a deformed Long / Lat grid. Fine readjusting the rotation of a partial image in an image processing program with decimals of a degree (this is what it handles about) is time consuming and unpredictable as it is difficult with practical reference means. Simple image processing programs can not rotate in smaller steps than 1 degree which is not sufficient for this type of work.

If you anyhow like to measure and fine adjust the skew of a partial image, use the NavPak Demo navigation program, *MapSetup*. Click two points on a straight line (horizontal or vertical) and select "Measure Skew". Note the measured value and open the map in a separate good image processing program and adjust by rotation. The skew may not be constant over the whole partial image (distorted original paper map or limited scanner performance), then use a mean value.

An alternative method would be to re cut the paper chart edges to become exactly parallel to the Lat / Long grid on all four sides and then rotate the paper chart and use the standard folding cover. A problem may occur if the scanning head sideways motion is not exactly perpendicular (square) to the carriage forward motion. The result may be a bent final grid. Also when working with more than two partial images rows you still will be in trouble.

Stitching together the different A4 images to the complete map

Stitch the different parts of the chart together in the **CCS** program from SPING, or a similar one. Please follow the manual.

Name the partial images like: 11, 12, 13, .../ 21 , 22, 23,...., for the first and second row, save in a folder with the name of the complete map, in order to finally stitch them easily on their right place. In CCS you open the partial images one by one, slowly moving them into their right place by the mouse or the arrow keys and stitch them in to the growing final map. Finally save the result in BMP or PNG format in

the same folder (to learn more about chart formats read the SC manual as well as the help section of the Ozi Explorer demo).
When stitching the partial images together in CCS you may sometimes notice that there is a slight discrepancy in scale, the partial images do not fit exactly along the whole joining line. There may be a slight backlash or yield in the scanner transmission or some other reason. If you have this problem, now and then recalibrate your scanner, will take a minute or so. Also decide if you want to have the best fit at the centre of the new chart or at the borders. A compromise may have to be done.

Stitching with "Marker Flags" (PanaVue or others) was very time consuming (to put all the markers on corresponding positions on the partial images and the processing time) and is not practical to day for chart making.

Do remember to attach artificially marked reference points with a pencil on the paper original in overlapping stitching areas where no natural common points are found in the open "white" sea. If you forget, you will have to rescan these areas to join the partial images with artificial joining points in a proper way.

Calibration to WGS 84, world co-ordinate system

Load the finished chart in the Chart directory of SeaClear II and open in Map Cal II. Follow the manual and calibrate with a number of points in relation to the geometrical quality of your new chart. Most professional charts I have checked are using one point per intersection of the main Long / Lat grid. Check the result carefully in relation to the electronic grid overlay. Also after calibration carefully check with the cursor that Long / Lat main intersections will result in almost "even numbers" and agree with the chart border scale values (neat line) and the paper chart. This calibration facility is good and very easy to use after some practising.

If you like to convert your chart to WCI format for disk mapping it is time to do it now (or before the calibration), follow the manual.

When working with many calibration points situated at Long/Lat main intersections on a "bent" map the grid mostly adjusts nicely between the points but sometimes becomes quite "bent" itself at the chart boarders (the original straight grid lines probably have been modified to become a "polynom" intersecting the calibration points or some other method). Then add an extra point on a grid line close to the boarder and move sideways in small steps and check how the overlay grid can be straightened up at the ends.

Setting the border line of the chart

Finally set border points defining the navigable area of the chart so the system can identify where the chart can be used. Then save and register your new chart. If you forget to manually set border points the system (SC) will perform an automatic setting when saving, corners of the final image. You can check the automatic border setting by reopening the chart in Map Cal II, and modify if desired to the corners of the neat line or other.

Shall You crop the border area of the chart, not usable for navigation to reduce file size?
This was considered extremely important earlier when working with BMP (file size) and PNG (loading time) format charts, being read from the RAM memory. By cropping off the border area, as much as 20 – 30% (?!) of the file size (MB) could be saved according to some reports, increasing performance. Chart area and file size grows with the square of the distance to the centre of the chart.

When running WCI format charts and disk mapping, the file size does not influence the loading time but it still occupies space on the hard disk.

With the border area still in place you can any time read all the information printed there, check the calibration and the chart Datum when desired (like on professional digital charts).

The choice is yours. Hard disk capacity has also increased with new computer models so it is to day not the problem it was earlier.

Making home made charts from captured digital screen originals

If you have digital demo charts which you can not directly use in your own plotting program (which functions with a GPS) but you can bring up on the PC screen in their own "viewer", you can capture them with help of the "print screen" technique by help of the **CCS** program from SPING. If you can move these charts sideways in fixed steps (for instance by the "tab key" or by "clicking" close to the border), the capturing and stitching process can be performed very quickly. You will have to find out how many steps will correspond to just under the screen width in the longitude direction and then "print". Decide the number of "clips" needed in the first row and then continue on the second one and the third .....

The advantage with this technique is that these charts almost always have clean single coloured areas and will compress very well to occupy a small disk space, just as professional charts do (they are).

The calibration (giving geo reference to the map) need some extra work as these charts may have no neat line. You have to read the Long / Lat positions of the main Long / Lat intersections of the original chart in the "original viewer" by putting the cursor on them, make a note and manually transfer them to your own new chart. Install in SC as for scanned charts.

Check the automatic loading of all your newly installed charts

As a routine measure check in planning mode that the next chart is loading when double clicking close to the borders (all directions) of each one of your new charts at home in simulation. You may have done something wrong during calibration.

It is also a good practice, as a test, to lay out an artificial route covering many charts and follow that in simulation and checking on a chart with a smaller scale (covering the new charts) that everything seems OK when moving around (create DR-positions) the artificial route. Something must definitely be wrong if suddenly the naval route is going over an island in the overlapping area when shifting to a new chart!!

This situation was, may be, more critical in the "old SeaClear I" if you forgot to fill in the co-ordinates for one of the two calibration points. No warning was given and the grid overlay did not show any deformation. In the new SC II a check with the grid overlay will warn you.

Nothing can be more confusing than that the next chart is not loading or the Long/Lat is completely wrong in live navigation.

Make your own digital charts from your own paper originals, navigate and have fun

This document may not contain the whole or final truth about home raster chart making and using but shows some of my personal experience during a 3-4 year trial and error period. With a modern fast scanner, rational guiding means and some training, it seems possible to make, calibrate and register a new A2 chart in about half an hour. When making too many practical errors (you always make errors now and then in practice) it may take quite longer. The active time for scanning a partial

A4 is less than a minute with a modern device (after pre viewing and cropping the image).
Be aware of that your own home scanned charts may have more and larger position errors than professionally digitised charts which have been made in one piece and checked by a staff of people. Remember also that home scanned maps will occupy a much larger hard disk space compared to professional ones as they will be "multi coloured", a result from the optical scanning process and may be even to the colours of the paper map. The professional maps are mostly made up of solid (single) coloured areas and the compression algorithms work more effectively

Also carefully keep in mind that the official paper charts them selves (the origin of your scanned maps) may contain general or local Long / Lat "off sets" (errors), sometimes of the order of 100 m or more because the surveying measurements (particularly for archipelago charts not used for commercial shipping) may be very old. When navigating the traditional way by taking bearings to visible points and triangulating (or simpler, just by common sense position yourself according to what you see around) to determine your position you are relatively safe because the close environment has mostly the same error. When plotting with GPS the reference is the "world co-ordinates" which knows nothing about general or local chart off set. Principally the same trouble would occur if you got the idea to pin point navigate in the archipelago with the help of "error free Celestial Observations". This is the situation to remember and to live with and this would be a headache of the Board of Charting in every country. In the age of GPS there are no exact maps, but this knowledge in combination with common sense will help us to navigate safer. The official charts are anyhow the best information we have.

If you are in doubt about spending time in making your own charts for GPS and computer navigation (you already have a GPS unit and a suitable computer, the SeaClear manual also tells the wiring diagram for the connection cable) scan and calibrate just one single partial A4 chart (no stitching needed) covering your home harbour area as a test. I did that and it was an exiting moment to see the boat position marker move on the screen for the first time when going out of the harbour. After that "chart making" has become one of my most beloved hobbies.

The price for professional digital charts may be of the order of $ 150-250 for an area (an area is a rough definition, for instance covering a coastal distance of the order of 50-100 NM). Remember that you anyhow need separate paper charts as a back up in an emergency. It may be difficult (or even illegal, check the copyright conditions from your digital chart supplier) to print out your official electronic

charts and glue the parts together to make a home made paper chart. Some skippers use their "multi decade" old paper charts on their own risk.
Never rely only on electronic charts, always double check with the paper chart and traditional navigating methods when navigating live.

Is there any real practical improvement to upgrade to DGPS for Yachtsmen?

With assumed possible errors of 100 m or more for the official charts (I have read somewhere that the Swedish Board of Naval Charting estimates that their charts may have an average positional "off set" of the order of 50 m) compared to the accuracy of GPS (assumed to of the order of 10-15 m during good conditions, year 2002), the chart must still be considered to be the weakest point.

With the new archipelago charts in scale 10 000 (from Hydrographica, Stockholm) over some local areas in the Stockholm external waters (estimated errors of the order of 5 m related to the world co-ordinates) a DGPS would improve the "whole system average performance".

A DGPS (Differential GPS, the GPS positions are locally corrected by a separate radio signal from a local station receiving GPS knowing its own true position) may also improve the position accuracy during bad atmospherical (radio) conditions.

Again, do not try to pin point navigate with the "world co-ordinates, WGS 84" for putting the ball into the hole, use optical observations (or radar means if you have, they both measure your position from the short distance real world).

How much smashing and shock can the computer on board stand in heavy whether or when touching under water obstacles?

What about the risk of damaging the computer hard disk during hard riding boat conditions? I have read few bad reports from private cruising people. Some skippers using fast lightweight power boats report that they have used a PC on board for a long time without damage. However from the previous (last) "Whitbread" I have read reports that several Lap Tops had stopped working after ocean racing (sail boats) in extreme weather, may be hard disk failure due to high shock when smashing into a hard wave? There is apparently a certain limit.

Vertical shock (acceleration square to the hard disk surface) seems to be most dangerous for the hard disk pickup to touch the running disk mechanically (Hard Disk may stop working).

The question is if the lost computers failed firmly clamped in the boat or came loose and fell to the floor, I do not know.
When hitting a hard wave or under water rock, what will be the "typical" direction, magnitude and duration of the shock in the boat and a firmly clamped computer? With such information available it would be possible to design a soft computer suspension reducing the shock values not to exceed the limit values in computer specification.

Until more knowledge is at hand, secure your computer on board firmly clamped down by rubber straps or Velcro means, it must not come loose!

What Navigation Program to run?

I am using **SeaClear** for archipelago- and some "Baltic Sea" navigation since I first found it on the web and started with electronic computer aided GPS navigation. It seems to be very robust and has never stopped working in live navigation during a 3-4 year test period. It is a "free ware" with all functions available and works in practical navigation as good as many other comparable "share ware" and "commercial" programs (you have to pay for) could be expected to do. It now also supports commercial raster chart formats. SC is easy to use and suits my mind, taste and needs fairly well. By intuition you quickly get used to work with all the functions available (mainly pop up menus with clear text, tree structure and few buttons. Key board shortcuts also exist). It is working fast and gives a large possibility of zooming in and out for overview (now down to 10%). Note that big charts due to limitations in WINDOWS itself can not be zoomed in above 200 %. I first started with the original SeaClear I for WIN 95 and is now quickly converting to the improved SeaClear II with the ability to use many calibration points for home made charts and also professional charts like BSB/ KAP and others. SeaClear is a modern program with many practical features for people with a demand for quick adaptation. SeaClear is flexible and runs with the "tray" visible, which means that you have direct access to other active computer programs or facilities (many "commercial" navigation programs can not be minimised for other temporary computer work, which may have its own reasons).

You can for instance make your own ships "compass deviation table" in digital form and run it minimised. Just click and you have it on the screen. Then quickly check that the true and magnetic courses do not disagree.

If you miss some functions for traditional navigation in SeaClear, as taking bearings to visible points and make triangulation to plot your position if the GPS fails, you may as an experiment try to manually run (minimised) a navigation demo program with this facility (NavPak). Before using for real navigation please check carefully how it handles your actual chart projection regarding true bearings!! By a clever chart path setting you may use the same charts. This may be better than nothing and you can avoid plotting on the paper chart (or you should do anyhow for safety reasons).

To use bearings in SeaClear itself to a limited degree, you can try to use the "Measuring Function" in automatic mode. Draw a line from the observed object in a direction of "360 deg minus your your observed bearing" (reverse direction of an optical or radio bearing) and compare with your assumed position. Only one line at a time, no intersection or saving seems possible for the moment. Corrections for magnetic deviation may be done the same way as plotting manually on paper. Make yourself clear about if the "SeaClear bearing" is true or magnetic, check in simulation how it will work.

Great circle- or celestial navigation may to day be considered as an "over doing" possibility for local navigators. I have checked in other navigation programs the difference between "rhumb line" and "great circle" navigation over the Baltic Sea from Sweden to Estonia. There is a quite notable difference in max cross track deviation, but the difference in sailed distance is still small. For world circuum navigators there will be quite a different situation. The absence in SC of "great circle" navigation may just mean a smaller program size.

GPS and Digital maps may influence your navigation practise

The traditional method of dead reckoning with holding compass course and recording of log elapsed distance still works and is very exiting. The forward view may soon or later resolve. The computer assisted GPS navigation will make the navigation more relaxed (sometimes boring) but you never have to rely solely on it.

GPS indicates "true" positions and directions when the boat is moving. In known waters (your target is more or less visible or selectable with some assistance of the screen view) you may after some time and practice start to navigate free from magnetic deviation, side wind, currents and course compensation.

Let the GPS course vector on the screen just aim on your target (particularly with auto pilot, manual course setting) and navigate intuitively on your own

responsibility, optically carefully checking what you observe around and which objects you pass. This is close to navigation in “home waters” where you not even use a chart and this may be the best “climax” ever in relaxed boating. Keep the paper chart ready if something fails.
Personally I always keep on board a still older Lap Top as a back up. It is working excellently with the new disk mapping technique.

Look Out !

When running on Auto Pilot (and looking into different GPS or Computer screens) you must be particularly careful about also having a regular “**visual look out”** in order not to get in a close situation or even collide with other boats. I had a few **“near misses”** and this can not be too heavily under lined and is your absolute responsibility as a skipper. Be aware of that a GPS does **not** show moving targets as a Radar is doing.

I navigate in a slow going 9 m motor boat with a sheltered “cock pit” which is relatively computer friendly regarding water spray. With the top open and a risk for light water spray or rain at hand the key board (but not the cooling air intake) of the Lap Top can be covered by thin “food wrapping” plastic film for some protection. For friends in fast power boats and sailboats more challenges of all kinds are awaiting. When not actively used for navigation bring down your computer to a drier or heated cabin to protect against high humidity and water.

What about a non PC chart plotting system with vector charts?

These always seem to be fully market priced hard- and software systems with a limited personal flexibility. Just buy and go ahead without any need of personal interest or knowledge in practical computer work.

They may however give many **advantages,** for instance:

1. The central unit is water proof, can probably be used in an unprotected cockpit of a sail boat.
2. The screens are sometimes stated to be easily red in bright sunlight.
3. The systems seem to be without a mechanical hard disk which can fail under heavy conditions or shock.
4. The vector charts will give opportunity to choose the amount of chart information needed for the time being.

5. The system start and uploading of new charts may be easy, you may just put in a new card.

There may be **disadvantages** too, for instance:

1. It seems to be few low cost "short cuts" available for the budget navigator.
2. The charts look different compared to the official paper chart appearance.
3. Will the available charts cover your favourite navigating areas (outside the commercial lanes) with the best available depth and other information (3 m curve)?
4. Can you complete with large scale local charts of your favourite natural areas and harbours?
5. How fast and easy do they work in planning mode compared to a PC with a conventional key board? PC users already have much of the knowledge to handle their system.

Many more points may be found, for and against. Please search information yourself.

I have for the moment no personal experience of these systems but the battle is going on.

Good luck in your raster chart making and digital navigation.

// **Anders Nilsson**
(Stockholm, Sweden)

andersharald@msn.com