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13th CHRIS MEETING
17-19 September 2001, Athens, Greece

REPORTS BY CHRIS WORKING GROUPS

TECHNOLOGY ASSESSMENT WORKING GROUP (TAWG)

(Mike Casey, Canada)

0. Introduction

The Objective of the CHRIS Technology Assessment Working Group from the Terms of Reference is:

> *"To assess the potential of present and developing information technology with respect to applications within the scope of CHRIS, and advise CHRIS accordingly."*

1. TAWG Members:

Australia	Ron Furness
Canada	Mike Casey
Germany	Horst Hecht
Netherlands	René van Geebergen
Sweden	Gõran Nordstrõom
United Kingdom	Chris Drinkwater
USA (NOAA)	Dave Enabnit
USA (NIMA)	Edwin Danford
MIO	Lee Alexander
PRIMAR	Robert Sandvik

2. Year 2001 Work Program

TAWG had three objectives for the year:

?? Review the technology status of high resolution Flat Panel Displays (FPD)
?? Establish user group on e-Commerce
?? Establish a user interest group on Print On Demand

3. Progress

Flat Panel Displays (FPD):

Sufficient technological progress has been made in the field of FPDs to warrant a re-examination of this technology as a substitute for CRTs in ECDIS. The review is warranted by the increasing use of FPDs in mainstream computing and the resulting improvements in colour accuracy, reliability, cost, footprint size and availability. Progress in FPDs will impact the colour standard in S-52 which is now specific to CRTs. A switch to FPDs is seen as progressive and evolutionary by system manufacturers and end-users. An abbreviated statement of work for the project is attached as Appendix 1. An Interim report will be available at the meeting.

e-Commerce:

No work has commenced on this topic this year.

Print On Demand (POD):
Under the leadership of Dave Enabnit of NOAA, a POD interest group has been formed via the OEF.

Appendix 1:
Evaluating The Current Performance Capabilities Of Flat Panel Displays For ECDIS

Objective: To evaluate the current performance capabilities of flat panel displays for ECDIS application, specifically:

- ?? Ability to achieve color performance targets over day and night tables
- ?? Review of viewing issues (like off angle performance)
- ?? Project performance trends that are important to ECDIS
- ?? Recommend engineering solutions to identified performance issues
- ?? Evaluation is intended to cover stand alone flat panels and laptop displays

Abbreviated Statement of Work:

Research the current state of the art in Flat Panel displays. This work is intended to find out who makes the best displays currently, and from that, identify a candidate(s) for evaluation.

Determine trends in display performance. The specific trends of interest will be related to off-to-on contrast ratio, viewing angle, color primary co-ordinates, and backlight control. This will be gathered through review of flat panel literature and discussions with manufacturers.

Measure actual performance of candidate displays. 2 displays will be chosen.

Evaluate the data and summarize the shortcomings of the display for both daytime and nighttime use.

Evaluate engineering opportunities to improve performance of the display

Write up the findings into a report which would identify the risks and opportunities of implementing current state of the art flat panel displays in ECDIS systems, and project performance improvements.

The work would be done in co-operation with DCIEM and draw on the experience of others such as Mathias Jonas of BSH in Germany and Hannu Peiponen of ASPO/Navintra in Finland.

APPENDIX

INTERIM REPORT ON LCD PERFORMANCE FOR ECDIS APPLICATION

Prepared for:

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Department of Fisheries and Oceans

By:
Matt Cowan,
Entertainment Technology Consultants

Summary:

The sample LCD monitor measured showed markedly improved performance over the panels measured 2 years ago. Brightness, contrast ratio, viewing angle, and colour gamut were all better. The calibration of the monitor for the bright_day table passed, although is “on the edge” for some colours.

The panel performance is indeed better than CRT performance in some respects. It is capable of being brighter, and the overall brightness can be controlled through adjustment of the backlight power, enabling substantial change in brightness without upsetting colour relationships.

It appears that the improved performance envelope could be usefully applied to ECDIS, providing better performance in bright environments, and a more useful means to control display brightness than available on CRT displays. This would involve the step of developing a separate colour table for LCD displays.

A more detailed performance analysis will be presented in the final report.

Introduction

This interim report is intended to give a first look at the performance envelope of the latest generation of LC display panels.

The panel chosen for testing was the NEC LCD 1810, a high performance panel with wide viewing angle and high inherent contrast ratio, and moderately high brightness

This report is not comprehensive, and is not the result of complete testing. It addresses some of the performance issues observed, and addresses the difficulties, and some potential opportunities resulting.

Performance Envelope

The ECDIS display has certain strict performance requirements to achieve adequate image quality. These are outlined in the table below.

Parameter	**ECDIS requirement**	**LDC Display**	**Implications/discussion**
Resolution	1280 x 1024	1280 x 1024	Meets. Sharper image than CRT due to display properties
Brightness	80 cd/m^2	>200 cd/m^2	Exceeds performance by 2.5 times. This provides an opportunity for better visibility and readability in bright ambient conditions
Contrast ratio	Not specified	400:1 measured 200:1 specified	Provides adequate black to white differentiation to achieve day table performance. Black level is too high to achieve night tables without making adjustments to the overall levels through backlight control
Colourimetry - Calibration	Wide enough to encompass all colours – Must calibrate successfully	Successfully calibrated for Day_Bright table	Darker tables were not tested. ND filters will be used to reduce the overall display luminance to test the dark table calibration capabilities.
Viewing angle	Not specified, but must be practical for possible viewing positions on bridge	Subtle colour shifts start occurring at <45 degrees (+/-)	This result probably represents a marginally acceptable case. While this is a substantial improvement over the displays measured 2 years ago, further work will be done to characterize the magnitude of the colour shift.

Parameter	ECDIS requirement	LDC Display	Implications/discussion
Night table performance	Black level controlled	Black level is fixed by contrast ratio and backlight condition	Some display engineering needs to be performed to achieve adequate luminance levels for application to the night tables.
White point	X=.280, y=.295	White is considerably yellower than ECDIS	This becomes an issue because to achieve a different white point, the display needs to be tuned – which necessarily means reducing the intensity of one or more of the R,G,B channels. This reduces the overall display intensity, without reducing the black level, thus reducing the dynamic range of the display.

Performance Issues

1. **Night tables:** Performance for these tables will only be achieved by reducing the overall light output of the display. Management of the backlight intensity or using neutral density filters in front of the display can easily do this. The intensity reduction required is about 40x (taking 80 cd/m^2 to 2 cd/m^2). It has been reported that several ECDIS display manufacturers have achieved backlight control with adequate range to achieve the desired results. This is very positive.
2. **Viewing Angle:** The achieved viewing angle is questionable for universal use of the display. The colour errors induced by off angle viewing may cause magenta, red and orange information to visually blend together. More characterization needs to be done on the display. Potentially this can be overcome with guidelines for placement of the display, to avoid off angle viewing situations.
3. **Maximum luminance:** The LCD outputs significantly more light than required for the strict ECDIS application. This issue is easily solved by reducing the backlight intensity.
4. **White point:** The natural white point being significantly off the ECDIS required white point reduces light output and dynamic range in the display. It appears that this difference is possible to calibrate in the display, but the magnitude of the correction is large and reduces overall potential display performance.

Possible Solutions and Opportunities

LCD technology offers several significant improvements over CRT technology. These could potentially be put to good use.

1. Brightness: The display offers significantly higher brightness than a CRT. It should be noted that the current limits on ECDIS brightness for the brightest day displays have been dictated by the practical limitations of the CRT technology. In fact, simulations of readability in a bright bridge situation have shown that more brightness would be very useful in improving readability of the display. Maybe there is an opportunity to use this extra brightness.
2. White point: The ECDIS white point chosen is probably the legacy of the natural white point of CRT's for computer graphics. The LCD display can be tuned to the ECDIS white point, but at the expense of performance (contrast and brightness). The display would be more powerful in its application with a different white point.
3. Brightness Control: In CRT displays we discourage the use of the brightness control – adjustments will cause the monitor to lose calibration. In LCD displays, the brightness control controls the backlight intensity. As such, the control manages the peak output intensity, and maintains the relative display performance parameters. It would be reasonable to allow the user to access this control, to make adjustments to suit the viewing environment.
4. Night Tables: The display will not achieve lower luminance performance without some design work on the backlight to substantially reduce its intensity. This is apparently being addressed successfully by several display manufacturers
5. Viewing angle needs further study. It may be necessary to limit the mariner's viewing angle of the display to ensure there is no confusion over colors.

From the above issues, it becomes apparent that the LCD display performance for ECDIS could be optimized to take advantage of the improved performance attributes. This would involve setting out a different set of colour tables for LCD displays.

These new tables would address:

- ?? Increased luminance for daytime tables
- ?? A means to control the brightness of the display over a broad range of luminance
- ?? Potential to reduce the number of tables required through use of a luminance control
- ?? Adjustment of some specific colours to accommodate a more optimized white point.

There is a downside to setting out new performance parameters for the LCD monitors. Colours will be different (both in intensity and chromaticity). If a bridge has both LCD and CRT displays installed, and there is potential for confusion resulting from different colours on each display, especially if they were mounted directly beside each other. The other issue is whether it would be appropriate define new colour tables in response to additional display technologies that might come along. (Note that new display technologies are not developing at a rapid rate, and thus the issue of accommodating new technologies will be moot for a number of years.)

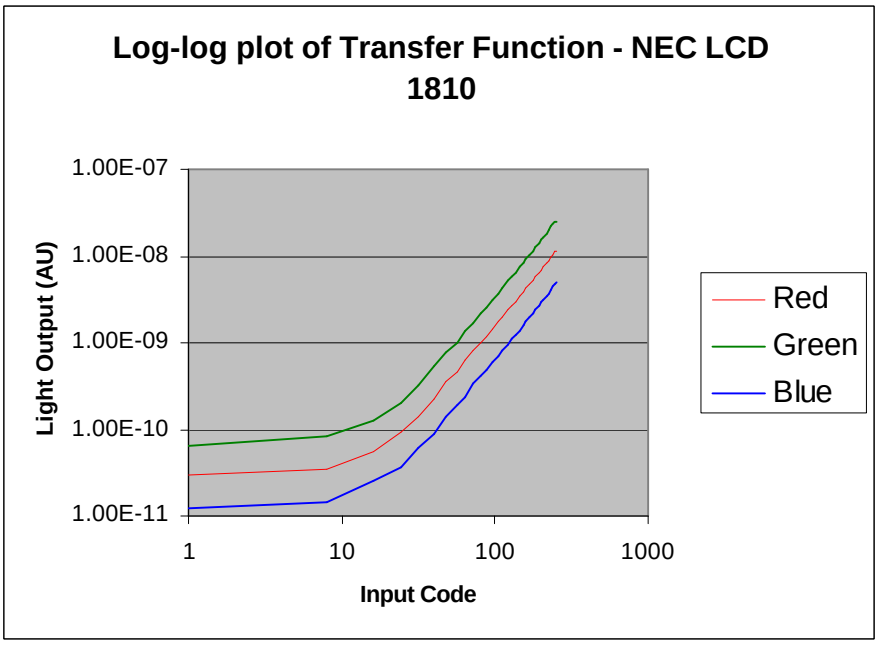
Preliminary Conclusions

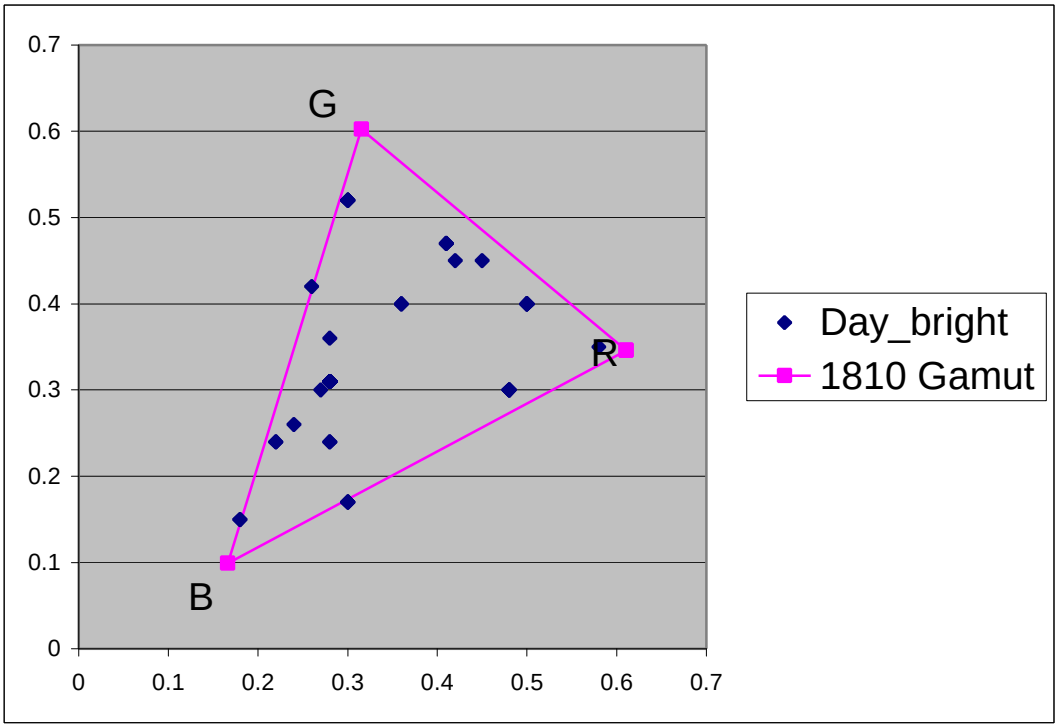
1. LCD displays appear to be close to achieving acceptable performance for ECDIS. Viewing angles and backlight control needs further study.
2. The LCD display offers performance enhancements over CRT displays. These enhancements will offer real user benefits, but will require some changes to the current display specifications
3. It is worthwhile to consider further the opportunity to use the additional performance available in LCD displays.

4. Annex 1: Calibration Results

Test Conditions:

Contrast (gain) set to max
Brightness (backlight) set to min
R,G,B multipliers (in display) set to max
On axis (perpendicular to screen)
F10 aperture on sensor





Plot showing the Day_bright colour table, and that all colours are achievable by the display. Note that there several colours that are marginal in performance – especially along the blue-green line. (These colours are within calibration tolerance.)

Calibration Results:

Table: Bright_sun

(token; colourname; x; y; L; R; G; B; Delta E)
NODTA;grey;0.2800;0.3100;45.000;101;146;161;0.204403
CURSR;orange;0.5000;0.4000;32.000;162; 98; 27;0.747314
CHBLK;black;0.2800;0.3100; 0.000; 0; 0; 0;0.000000
CHGRD;grey;0.2800;0.3100;25.000; 75;112;121;0.154152
CHGRF;grey;0.2800;0.3100;45.000;101;146;161;0.204403
CHRED;red;0.4800;0.3000;25.000;168; 48; 84;0.729624
CHGRN;green;0.3000;0.5200;60.000; 34;194; 75;0.134732
CHYLW;yellow;0.4100;0.4700;70.000;164;183; 60;0.283196
CHMGD;magenta;0.3000;0.1700;20.000;135; 0;170;3.748648
CHMGF;magenta;0.2800;0.2400;48.000;140;125;205;0.436237
CHBRN;brown;0.4200;0.4500;30.000;117;118; 36;1.008593
CHWHT;white;0.2800;0.3100;80.000;134;190;212;0.342787
SCLBR;orange;0.5000;0.4000;32.000;162; 98; 27;0.747314
CHCOR;orange;0.5000;0.4000;32.000;162; 98; 27;0.747314
LITRD;red;0.4800;0.3000;25.000;168; 48; 84;0.729624
LITGN;green;0.3000;0.5200;60.000; 34;194; 75;0.134732
LITYW;yellow;0.4100;0.4700;70.000;164;183; 60;0.283196
ISDNG;magenta;0.3000;0.1700;20.000;135; 0;170;3.748648
DNGHL;red;0.4800;0.3000;25.000;168; 48; 84;0.729624
TRFCD;magenta;0.3000;0.1700;20.000;135; 0;170;3.748648

TRFCF;magenta;0.2800;0.2400;48.000;140;125;205;0.436237
LANDA;brown;0.3600;0.4000;49.000;132;153;106;0.500774
LANDF;brown;0.4500;0.4500;15.000; 91; 82; 0;6.600044
CSTLN;grey;0.2800;0.3100;10.000; 45; 71; 72;0.238112
SNDG1;grey;0.2800;0.3100;25.000; 75;112;121;0.154152
SNDG2;black;0.2800;0.3100; 0.000; 0; 0; 0;0.000000
DEPSC;grey;0.2800;0.3100;10.000; 45; 71; 72;0.238112
DEPCN;grey;0.2800;0.3100;25.000; 75;112;121;0.154152
DEPDW;white;0.2800;0.3100;80.000;134;190;212;0.342787
DEPMD;pale_blue;0.2700;0.3000;65.000;114;173;199;0.687604
DEPMS;light_blue;0.2400;0.2600;55.000; 88;158;216;0.566169
DEPVS;medium_blue;0.2200;0.2400;45.000; 54;144;212;0.212817
DEPIT;yellow-green;0.2800;0.3600;40.000; 74;147;129;0.308417
RADHI;green;0.3000;0.5200;20.000; 0;116; 31;1.235672
RADLO;green;0.3000;0.5200;60.000; 34;194; 75;0.134732
ARPAT;green;0.2600;0.4200;30.000; 0;139; 95;3.640710
NINFO;orange;0.5000;0.4000;32.000;162; 98; 27;0.747314
RESBL;blue;0.1800;0.1500;22.000; 0; 81;212;3.114673
ADINF;yellow;0.4100;0.4700;35.000;116;133; 32;0.330224
RESGR;grey;0.2800;0.3100;25.000; 75;112;121;0.154152
SHIPS;black;0.2800;0.3100; 0.000; 0; 0; 0;0.000000
PSTRK;black;0.2800;0.3100; 0.000; 0; 0; 0;0.000000
SYTRK;grey;0.2800;0.3100;25.000; 75;112;121;0.154152
PLRTE;red;0.5800;0.3500;18.000;153; 33; 0;6.494718
APLRT;orange;0.5000;0.4000;32.000;162; 98; 27;0.747314
UINFD;black;0.2800;0.3100; 0.000; 0; 0; 0;0.000000
UINFF;grey;0.2800;0.3100;25.000; 75;112;121;0.154152
UIBCK;white;0.2800;0.3100;80.000;134;190;212;0.342787
UIAFD;medium_blue;0.2200;0.2400;45.000; 54;144;212;0.212817
UINFR;red;0.4800;0.3000;25.000;168; 48; 84;0.729624
UINFG;green;0.3000;0.5200;60.000; 34;194; 75;0.134732
UINFO;orange;0.5000;0.4000;32.000;162; 98; 27;0.747314
UINFB;blue;0.1800;0.1500;22.000; 0; 81;212;3.114673
UINFM;magenta;0.3000;0.1700;20.000;135; 0;170;3.748648
UIBDR;grey;0.2800;0.3100;25.000; 75;112;121;0.154152
UIAFF;brown;0.3600;0.4000;49.000;132;153;106;0.500774
OUTLW;black;0.2800;0.3100; 0.000; 0; 0; 0;0.000000
OUTLL;brown;0.3600;0.4000;49.000;132;153;106;0.500774
RES01;grey;0.2800;0.3100;45.000;101;146;161;0.204403
RES02;grey;0.2800;0.3100;45.000;101;146;161;0.204403
RES03;grey;0.2800;0.3100;45.000;101;146;161;0.204403
RES04;grey;0.2800;0.3100;45.000;101;146;161;0.204403
RES05;grey;0.2800;0.3100;45.000;101;146;161;0.204403

Darker tables were not simulated, but will be considered in the final report.