

## STANDARD-RELATED ACTIVITIES AND ISPRS TC I

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### ABSTRACT:

The paper reviews activities of interest to ISPRS taking place within ISO, CEOS and in colour systems. The ISO activities summarized here concern standards in photography, in optical instrumentation with emphasis on image quality determination, in space data and information transfer systems and in quality management. The CEOS activities are presented with an emphasis on those of the WG on Calibration and Validation and its subgroup on Terrain Mapping. A short summary of international activities in regard to colour ordering systems shows a somewhat unclear situation with a larger number of systems. The paper concludes with a call for a stronger involvement of ISPRS in those ISO and CEOS activities relevant to ISPRS activities.

### KURZFASSUNG:

Der Bericht gibt einen Überblick über für die Internationale Gesellschaft für Photogrammetrie und Fernerkundung (ISPRS) interessante Aktivitäten in der Internationalen Organisation für Normung (ISO), der Organisation der satellitenbetreibenden internationalen und nationalen Behörden (CEOS) und bezüglich Farbsystemen. Die hier zusammengefaßten ISO-Aktivitäten betreffen die Normierungsbereiche Photographie, optische Geräte mit Betonung auf die Bestimmung von Bildqualität, Weltraumdaten und -informationsübertragungssysteme und Qualitätsmanagement. Die CEOS-Aktivitäten werden zusammengefaßt mit besonderem Augenmerk auf die Tätigkeit der Arbeitsgruppe für Kalibrierung und Validierung und deren Untergruppe, die sich mit der Geländeaufnahme (vorrangig der Höhe) befaßt. Der Überblick über die internationalen Bemühungen um eine Normierung von Farbordnungssystemen zeigt eine etwas unklare Situation mit dem Ergebnis, daß verschiedene Systeme genutzt werden. Der Bericht schließt mit der Empfehlung an die ISPRS, sich verstärkt an jenen Tätigkeiten von ISO und CEOS zu beteiligen, die für die Mitglieder der Gesellschaft von Bedeutung sind.

## 1. INTRODUCTION

Technical Commission (TC) I of ISPRS has a history in the development of standard-type documents, namely a "Recommended Procedures for Calibrating Aerial Cameras and for Related Optical Tests" and a "Specification for Aerial Survey Photography". The first document was developed during the late forties and fifties at a time when international standardization in the optical field did not yet take place; this development represented a major part in the activities of TC I: It has been repealed awaiting a systematic reworking based on now existing international standards but is nonetheless still used as reference document for example in a German standard. The second document was developed in the early eighties and remains in force today although it has proven difficult to establish the extent of its use.

In recognition of the fact international standardization in the photographic and optical fields had been established, ISPRS TC I entered into several and plans to enter into additional liaison agreements with several Technical Committees (TC's) of the International Organisation for Standardization (ISO) thus establishing a mechanism for passive or even active participation in the development of international standards. A review will be given of the present situation and of work of interest taking place in ISO TC 42 (Photography) and several Subcommittees (SC's) of TC 172 (Optical Instrumentation) and TC 20 (Aircraft and Space Vehicles). ISO has developed international standards for quality management (ISO 9000 etc.). These standards are also of interest for the photogrammetric community, e.g. in connection with the

"Specification for Aerial Survey Photography", and they will therefore be reviewed as well.

The Committee on Earth Observations (CEOS) is an international body with satellite-operating agencies as members. A previous attempt to gain for ISPRS the status of an "Observing Member" failed, and a new application should be made. The CEOS activities are carried out in working groups. Of particular interest to TC I is Working Group on Calibration and Validation (WGCV), which has several subgroups, e.g. one for terrain mapping. The WGCV activities of interest to TC I will also be reviewed. CEOS goes their own way in regard to standards; this way will be described.

Other standard activities possibly of interest to TC I concern colour. A short review over the situation in colour standardization will also be given. As this topic was discussed in a workshop of WG I/1, the workshop results in this and other topics will be introduced.

## 2. INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

Standardization takes place on three levels: global, regional and national. Global agencies are ISO, operating since 1947, and the International Electrotechnical Commission (IEC), established 1906. A formal agreement between them states that standardization in the electrical and electronic fields are the concern of IEC, all other subjects of ISO. Another international agency involved with standardization is the International Telecommunication Union (ITU), established in

1865, with its International Telephone and Telegraph Consultative Committee (CCITT). All these bodies are located in Geneva.

ISPRS TC I has entered into active liaison agreements (category "A": "effective contribution to the work") with ISO TC 42 (Photography) and TC 172 / SC 9 (Optical Instrumentation / Electro-optical Systems), and in passive liaison (category "B": "wish to be kept informed only") with SC 13 of TC 20.

Also reviewed will be the activities of TC 176 (Quality management and quality assurance).

## 2.1 ISO TC 42

This TC is not divided directly into Working Groups (WG's) omitting the usual first division into SC's: As ISO groups are disbanded after completion of their work without a reuse of the respective group numbers, the WG numbers no longer form a continuous list

- 2 Photoflash units,
- 3 Sensitometry, image measurement and viewing,
- 4 Mechanical elements of photographic equipment,
- 5 Physical property and image performance of photographic materials,
- 6 Photographic chemicals and processing,
- 8 Photographic film and paper products - Dimensions,
- 9 Still projectors and transparencies,
- 12 Lens quality characteristics,
- 15 Glossary of technical terms and definitions in photographic standards,
- 17 Joint TC42/WG3-TC106-FDI WG: Revision of ISO 3665,
- 18 Electronic still picture imaging.

The work of WG's #3, 5, 6, 12 and 18 is very much of interest to those within the photogrammetric community concerned with picture data acquisition. Other groups also deal with aspects of interest such as e.g. WG #4 with shutters. Current work items of interest are:

- ISO speed determination:
  - ISO 5800:1987 (R1992):  
Colour negative films for still photography,
  - ISO 6846:1992  
Black-and-white continuous-tone papers (speed and ISO range for printing),
  - ISO 2240:1994:  
Colour reversal films,
  - ISO 6:1993:  
Black-and-white pictorial still camera negative film/process systems,
  - ISO 7829:1986:  
**Black-and-white aerial camera films (speed and average gradient),**
- Density measurements:
  - ISO 5-1:1984 (R1994):  
Terms, symbols and notations,
  - ISO 5-2:1991 (under review):  
Geometric conditions for transmission density,
  - ISO 5-3:1984 (under review):  
Spectral conditions,
  - ISO 5-4:1995:  
Geometric conditions for reflection density,
  - ISO 5800:1987 (R1992):  
Colour negative films for still photography,
  - ISO 42N 3339:

Method for the determination of densitometer performance specifications.

- Other
  - ISO 6728:1983 (R1993):  
Determination of ISO colour contribution index,
  - ISO 7589:1984 (R 1994):  
Specifications for daylight and incandescent tungsten illuminants for sensitometry,
  - ISO 6328:1982 (under review):  
Determination of ISO resolving power of photographic materials,
  - ISO 3664:1975 (under review):  
Viewing conditions for photographic prints, photomechanical reproductions and transparencies,
  - ISO NWI:  
Root-mean-square granularity of photographic films -  
Method of measurement.

An item of particular interest to photogrammetrists is marked in bold. Complaints from an aerial camera manufacturer after receipt of this new standard developed without a representation from ISPRS to the author in his function as WG chairman was the impetus for ISPRS TC I to seek a liaison agreement with ISO TC 42. Attempts will be made to provide during the ongoing revision process current technical data about photogrammetric camera systems.

A recent inquiry has shown that no ISO standards defining concerning the speed of infrared film exist even so manufacturers list a speed value.

## 2.2 ISO TC 172

This TC has nine SC's:

- Fundamental standards,
- Materials for optical processing,
- Optical materials and components,
- Telescopic systems,
- Microscopes,
- Geodetic instruments,
- Ophthalmic, endoscopic, metrological instruments and test methods,
- Ophthalmic optics,
- Electro-optical systems.

ISPRS TC I has entered into active liaison agreement with SC 9; an agreement with SC 1 remains to be reached. The activities of these SC's will be reviewed.

### 2.2.1 ISO TC 172 / SC 1: This SC has four WG's:

- General optical test methods,
- Preparation of drawings for optical instruments and systems,
- Environmental test methods,
- Electronic data transfer.

Of interest are in particular the activities of the first and last of these groups. Work items developed by the first WG of interest in view of a reworking of the "Recommended Procedures ..." are

- Lens distortion:
  - ISO 9039:  
Determination of distortion,
- Optical transfer function (OTF):
  - ISO 9334:1995:  
Definitions and mathematical relationships,
  - ISO 9335:1995:

Principles and procedures of measurement,  
ISO/DIS 11421:1994:

Accuracy of measurement,

- Veiling glare:  
ISO 9358:1994:  
Definitions and methods of measurement,
- Vignetting:  
ISO/DIS 13653:1994:  
Method of measuring the relative irradiance in the image field.

Under discussion are new standards dealing with the determination of the focal length and the measurement of the OTF of sampling imaging systems. An active liaison member has the possibility to make proposals for new work items: of particular interest in this context is the possibility to propose a standard in the ISO 9336 series dealing with OTF applications in regard to aerial camera lenses.

**2.2.2 ISO TC 172 / SC 9:** This SC has seven WG's:

- Terminology and test methods for lasers,
- Interfaces and system specifications for lasers,
- Safety,
- Laser systems for medical applications,
- Laser systems for general applications,
- Optical components and their test methods,
- Electro-optical systems other than lasers.

Of interest are in particular the activities of the last two groups. Work items developed by WG #6 are

- Standard optical components:  
ISO/DIS 11151-1:  
Components for UV, visible and near-IR,  
ISO/DIS 11151-2:  
Components for the infrared spectral range
- Test methods:  
ISO/WI 13696:  
Test method for radiation scattered by optical components,  
ISO/WI 13697:  
Test methods for radiation reflectance and transmittance of optical components.

The efforts of WG #7 are directed towards facilitating compatibility and interchangeability of (1) I/O chips, (2) optical fiber arrays and (3) microlens arrays for telecommunication and sensor applications; measurement techniques are to be developed as necessary but it is not the intend of the group to standardize the parameter values.

### 2.3 ISO TC 20

This TC has 11 SC's:

- 1 Aerospace electrical requirements,
- 3 Concepts, quantities and symbols for flight dynamics,
- 4 Aerospace fastener systems,
- 5 Environmental and operational conditions for aircraft equipment,
- 6 Standard atmosphere,
- 8 Aerospace terminology,
- 9 Air cargo and ground equipment,
- 10 Aerospace fluid systems and components,
- 12 Mechanical system parts,
- 13 Space data and information transfer systems,
- 14 Space systems and operations.

SC #13 is concerned with the development of space interface standards, protocols and operational procedures/services for the interoperability and cross-support among space facilities and supporting ground-based facilities. The program of work includes the following activities of which the last is of interest to data users:

- Space-to-space communication links,
- Space-to-ground communication links,
- Application layer protocols/services for ground communication,
- Archival data structures, tools and services.

### 2.4 ISO TC 176

This TC was formed in 1979 in response to the fact that various national and multinational standards in the quality systems arena for commercial, industrial and military use lacked sufficient consistency for widespread use in international trade. Terminology in these standards and in commercial and industrial practice also was inconsistent and confusing.

The TC has three SC's:

- Concepts and terminology,
- Quality systems,
- Supporting technologies.

From 1987 onward the following standards on "quality management and quality assurance" were issued:

- ISO 8402:1994:  
Vocabulary,
- ISO 9000-1:1994:  
Part 1: Guidelines for selection and use,
- ISO 9000-2:1993:  
Part 2: Generic guidelines for the application of ISO 9001, ISO 9002 and ISO 9003,
- ISO 9000-3:1991:  
Part 3: Guidelines for the application of ISO 9001 to the development, supply and maintenance of software,
- ISO 9000-4:1993:  
Part 4: Guide to dependability programme management.

At the same time the following standards on "quality systems" were developed:

- ISO 9001:1994:  
Model for quality assurance in design, development, production, installation and servicing,
- ISO 9002:1994:  
Model for quality assurance in production, installation and servicing,
- ISO 9003:1994:  
Model for quality assurance in final inspection and test.

The series of standards is completed by the following standards on "quality management and quality system elements":

- ISO 9004-1:1994:  
Part 1: Guidelines,
- ISO 9004-2:1991:  
Part 2: Guidelines for services,
- ISO 9004-3:1993:  
Part 3: Guidelines for processed materials,
- ISO 9004-4:1993:  
Part 4: Guidelines for quality improvement,
- ISO/DIS 9004-5:1994:  
Part 5: Guidelines for quality plans,
- ISO/DIS 9004-7:1994:  
Part 7: Guidelines for configuration management.

The ISO 9000 series of standards embodies comprehensive quality management concepts and guidance, together with several models for external quality assurance requirements. It is accompanied by a series of related standards, the ISO 10000 series, e.g.:

- ISO 10011-1:1990:  
"Guidelines for auditing quality systems" Part 1:  
Auditing,
- ISO 10011-2:1991:  
"Guidelines for auditing quality systems" Part 2:  
Qualification criteria for quality systems auditors,
- ISO 10011-3:1991:  
"Guidelines for auditing quality systems" Part 3:  
Management of audit programmes,
- ISO 10012-1:1992:  
"Guidelines assurance requirements for measuring equipment" Part 1:  
Metrological confirmation system for measuring equipment,
- ISO/DIS 10013:1993:  
"Guidelines for developing quality manuals".

Efforts are underway in several countries to achieve quality management certification under the ISO 9000 program also in the surveying field. Being certified has become a competitive tool for companies as it includes auditing a company by a single accredited independent (third-party) registrar organization. Such a third-party certification scheme provides a number of benefits: certification demonstrates that a company has implemented an adequate quality system for the products or services it offers; by this, better internal commitment as well as enhanced purchaser confidence may be achieved.

### 3. REGIONAL STANDARDIZATION (EUROPE)

The task of creating a uniform body of standards meeting modern needs and applying throughout a single European Market is the responsibility of the Joint European Standards Institute CEN/CENELEC and ETSI based in Brussels, in an association comprising the national standards bodies and electrotechnical committees of the member states of the European Union as well as of Iceland, Norway and Switzerland.

CEN (Comité Européen de Normalisation), CENELEC (Comité Européen de Normalisation Electrotechnique) and ETSI European Telecommunications Standards Institute) are the European counterparts to ISO, IEC and CCITT. However, CEN and CENELEC were founded in the early 1960's and agreed in 1982 to collaborate as a joint European standards institution.

European standards are generally based on standards of ISO, IEC or CCITT. However, specifically European standards are also created in cases where corresponding international standards are not yet available.

In 1991, agreements regarding technical collaboration and the avoidance of parallel standard development were made between ISO and CEN, and IEC and CENELEC, respectively. The agreements require that each new standard project with CEN/ CENELEC needs to be checked first to determine whether this project could not be handled by ISO or IEC. This process requires that the new international standards reflect the technical state of development in Europe and fulfil the EC-"basic requirements". It is further desirable that non-European ISO and IEC members, in particular the USA and Japan, are

prepared to accept those standards as national standards. Hence, international (e.g. ISO) and regional (e.g. CEN) standard development procedures have been harmonized and include cross connections in the various comment and voting stages.

The standards of ISO 9000 series have all become European standards as well.

### 4. COMMITTEE ON EARTH OBSERVATIONS (CEOS)

The collective space programmes of the world have reached a level where distinctions between the existing missions result from the technology involved rather than the disciplines served. CEOS was formed in 1984 as an outgrowth of the International Economic Summit of the Industrial Nations (G-7) Working Group on Growth, Technology, and Employment's Panel of Experts on Satellite Remote Sensing, which was examining co-operation of technologies, to co-ordinate informally current and planned systems for Earth observations.

#### 4.1 CEOS Objectives

The CEOS has as members Governmental organizations that are international or national in nature and are responsible for civil spaceborne Earth observations programmes currently operating or at least in the definition phase (phase B). The CEOS three primary objectives:

- to optimize the benefits of spaceborne Earth observations through co-operation of its members in mission planning and in the development of compatible data products, formats, services, applications and policies;
- to aid both its members and the international user community by inter alia serving as the focal point for international co-operation of space-related Earth observations activities, including those related to global change; and
- to exchange policy and technical information to encourage complementarity and compability among spaceborne Earth observation systems currently in service and development, and the data received from them.

Issues of common interest across the spectrum of Earth observation satellites will be addressed. CEOS does not operate independently but co-operates with other international organizations which have affiliate status (see 4.4 below).

CEOS has at present two WG's: the WG on Calibration and Validation (WGCV) and the WG on Information Systems and Services (WGINS) which was recently formed by combining two former WG's, the WG on Data (WGD) and the WG on Information Systems and Services (WGISS).

#### 4.2 CEOS WG on Calibration and Validation

The CEOS recognized already in 1984 the need to both understand and quantify current and future data to be derived from a larger number of Earth observing satellites and established WGCV. The work of the group has taken on a more important role since 1990 when the full importance of high-quality satellite data and potential climate change observations came to the forefront. The WGCV has developed an as yet unpublished strategic plan to address the future of high-quality satellite data.

The objectives of the WGCV are to enhance co-ordination and complementarity, to promote international co-operation and to focus activities in the calibration ("*... the process of quantita-*

tively defining the system response to known, controlled signal inputs") and validation ("... the process of assessing by independent means the quality of the data products derived from the system outputs") of Earth observations for the benefit of CEOS members and the international user community.

The WGCV has four subgroups. In the order of their creation, these are

- the Synthetic Aperture Radar (SAR) Calibration Subgroup,
- the Infrared and Optical Sensors Subgroup (IVOS),
- the (passive) Microwave Sensors Subgroup (MSSG),
- the Terrain Mapping Subgroup (TM).

**4.2.1 SAR Cal:** This very active group has established procedures for SAR performance assessment techniques, (internal and external) calibration techniques, formats and definitions. It has co-ordinated multinational calibration campaign to develop expertise for intra-sensor and cross-sensor calibration, has participated in ERS-1, RADARSAT and SIR-C/X-SAR calibration activities and has held SAR calibration workshops at regular intervals. The group is about to change the scope of its activities.

**4.2.2 IVOS:** This group promotes international and national co-operation in the calibration and validation of all (satellite, airborne and ground-based) IVOS, with an emphasis on systems providing global coverage, to assist in an improved application of data from all sensors. As part of identifying calibration and validation requirements, the group attempts to identify test sites to facilitate intercomparisons of the data provided by different sensors.

**4.2.3 MSSG:** This group is concerned with all microwave sensors excluding SAR and promotes a.o. accurate sensor calibration and validation through the establishment of laboratory-type standard calibration targets, including electromagnetic characteristics of reference targets, describing methods for reference temperatures, developing recommendations for field-use portable standard calibration targets and recommending requirements for antenna characterization. Other objectives are the establishment of general characteristics for in-flight (spaceborne) calibration targets, the investigation of calibration reference target designs and the establishment of recommendations for end-to-end analysis of in-flight calibration techniques.

**4.2.4 TM:** This group is for the ISPRS community without doubt the most interesting one. The Terrain mapping Subgroup has the following terms of reference:

- to promote wider awareness and use of remote sensing satellite data for terrain height determination;
- to promote an intercomparison of the state-of-the-art in the different techniques for determining terrain heights from space and their validation, to work towards common terminology and to determine terrain height accuracies including the following techniques: optical stereo, SAR stereo, SAR interferometry, shape-from-shading, laser altimetry, radar altimetry and others;
- to identify and/or establish relatively stable test sites accessible by a variety of sensors. (Reference data sets accurate enough to allow validation of various space methods are being assembled in suitable aggregated form to meet different resolution requirements; data from different sensors and reference data sets are freely made available to members of the subgroup)

The subgroup has in the past few years been a strong supporter of sensor requirements needed to enable SAR interferometry, and has succeeded in obtaining operational parameters of ESA's ERS-1/ERS-2 tandem mission suitable for SAR interferometry.

One of the activities of all subgroups is the preparation of a test site dossier which gives for selected sites the following information, if available:

- site name,
- contact name and address,
- site characteristics (location, size, relief, climate, vegetation, geology, previous use),
- DEM characteristics (spacing, source, extent, accuracy),
- map coverage,
- ground control point availability,
- available image data,
- references.

Access to these test data would undoubtedly be of interest to the ISPRS community. This requires, however, affiliate status with the CEOS.

The TM subgroup has also looked into the question of evaluating DEM's derived from spaceborne data and has to prepare a guide to the methodology of evaluation.

#### 4.3 CEOS WG on Information Systems and Services

The WGINs has four subgroups:

- the Format Subgroup (FS)  
deals a.o. with format system requirements, CEOS superstructure, CEOS SAR formats, data compression, data description languages, data objects and format translations,
- the Auxiliary Data Subgroup (ADS)  
is surveying current auxiliary data usage for product generation, preparing guidelines and recommendations, and has begun (in co-operation with FS) a task force on global mapping aiming at establishing a Global Land One-kilometre Base Elevation (GLOBE) elevation model,
- the Catalogue Subgroup (CS)  
carries out its activities by several task teams (International Directory Network, CEOS Inventory Interoperability Experiment, Protocol Definition, Browse, World Wide Web, Guidelines),
- the Network Subgroup (NS)  
has task teams for Browse, IDN, CINTEX, Performance Measurement, 1-km AVHRR and Network Register and is also works on network security, networking among CEOS agencies and new technologies.

#### 4.4 CEOS Participants

In addition to the member Governmental organizations identified under 4.1 the CEOS has two additional classes of membership, observers and affiliates. Observers are governmental organizations that are international or national in nature and currently have a civil space-segment activity in Phase-A (*preliminary analysis to determine whether a candidate mission is needed, feasible and compatible with agency goals and technology state-of-the-art*)/pre-Phase-A (*advanced study to determine new and promising missions deserving further study - not yet a part of the project cycle life*) or equivalent of system development, or a significant ground-segment activity that supports CEOS objectives. Observer status is granted by invitation of the CEOS members. There are at present four observers.

Affiliate status is granted by the CEOS members in order to establish links to other satellite co-ordinating groups and to scientific or governmental bodies that are international in nature and currently have a significant programmatic activity that supports CEOS objectives. Currently, the following organizations hold affiliate status:

- FAO (Food and Agricultural Organization of the United Nations),
- GCOS (Global Climate Observing Program),
- GOOS (Global Oceans Observing Program),
- ICSU (International Council of Scientific Unions),
- IGBP (International Geosphere-Biosphere Program),
- IOC (Intergovernmental Oceanographic Commission),
- UNEP United Nations Educational Program),
- UNOOSA (United Nations Office for Outer Space Activities?),
- WCRP (World Climate Research Program),
- WMO (World Meteorological Organization).

A previous application of ISPRS for affiliate status was denied by the CEOS Plenary on the ground that ISPRS is primarily an international lobby organization rather than a scientific body. A renewed application for affiliate status requires good preparation and some lobbying with CEOS members; however, the addition of the Terrain Mapping subgroup in the WGCV should make it significantly easier to argue that ISPRS has "a significant programmatic activity that supports CEOS objectives". The author believes that **an active participation of ISPRS in CEOS activities, especially terrain mapping, will be beneficial to future ISPRS activities.**

## 5. INTERNATIONAL STANDARDIZATION IN COLOUR ORDER SYSTEMS

"Colour" is not an easy subject to deal with as it involves the combination of two aspects, colour stimulus and colour perception.

Colour stimulus refers to the physical aspects of colour, the electromagnetic radiation with a certain spectral distribution which can be measured. Colour-stimulus related questions can be discussed under the heading colour optics, and they include for example

- radiant energy,
- wavelength and colour,
- monochromatic stimuli,
- fluorescence,
- colour temperature,
- colour mixture (better colour-stimulus synthesis),
- three-colour separation,
- colour printing.

Colour perception refers to psychological aspects of colour, that is the way in which we perceive colour. The psychological aspects of colour are closely related to the physiological aspects of colour, that is the way in which the human visual nerve system works.

The combination of the physical and the psychological aspects of colour leads to a psychophysical way to treat colours which resulted in a scientific branch called colorimetry. The Human visual system is here treated like a black box.

Colour systems gain additional interest as a result of an increase use of either digital imaging systems or of digitized images. A few colour systems will now be reviewed briefly.

### 5.1 CIE System

This CIE colorimetric system is basically a method of analyzing colour stimuli with respect to their ability to generate colour percepts. It is based on the ability of the human visual system to see a monochromatic colour stimulus and a mixture of three primary colour stimuli as the same colour metamery). Hence, it is possible to define all visible colours as a mixture of three primary stimuli. The International Illumination Commission (CIE from Commission Internationale de l'Éclairage) has determined the response of standard observers for a 2° and a 10° visual field, the spectral characteristics of standard light sources and a system of describing colours known as chromaticity diagram.

Based on the chromaticity co-ordinates, two colour spaces for the evaluation of small stimulus differences were in 1976 temporarily accepted by CIE after a long dispute and repealed a few years ago: CIELAB and CIELUV. CIELAB proved to be more useful in connection with reflective material (Photographic prints, printed materials), CIELUV for projected images (television).

### 5.2 NCS and Munsell Systems

A set of three elementary colours has long been used as base colours. These colours were later combined in three opponent pairs (white-black, yellow-blue, red-green) in recognition of the fact that signals from the trichromatic receptor system in the retina are processed to polarities. Hence, this psychological system is known as Natural Colour System. It has become under that name a Swedish national standard and has been considered for introduction as an international standard but work was discontinued for the time being as the Swedish system carries a personal copyright unacceptable to ISO. The system is physically realized in form of a colour atlas containing a large number of colorimetrically specified samples, and the colorimetric specifications are tied to a certain CIE standard illuminant and standard observer

The other major system beside the NCS is the Munsell system also based on a colour atlas. While the NCS colours fit reasonably equally distributed into a double cone, have the Munsell colours a more irregular distribution leading to a presentation in a Munsell tree. Also, the three chromatic opponent pairs are not in exact opposite positions on Munsell's colour circle.

### 5.3 Monitor colour systems

Monitors use primary colours determined by available pigments; these have nothing to do with the CIE primary stimuli. In recognition of the fact that colours can be interactively better controlled or transmitted with a certain degree of loss-free data compression, transformations into several monitor colour spaces have become common:

- HSV (hue, saturation, value),
- HLS (hue, lightness, saturation),
- HVC (hue, value, chroma),
- IHS or HIS (hue, intensity, saturation),
- YIQ (luminance Y, red - Y, blue - Y used in NTSC),
- YCC (Kodak system similar to NTSC)

The terminology is somewhat ambiguous but one can give the following short explanations:

- hue: attribute defining colour, e.g. the dominant wavelength,
- saturation: colour strength judged in relation to lightness,
- value: square root of the luminous appearance of reflectance,
- lightness: goes from black to white along the grey axis,
- chroma: a measure of the distance from the grey axis on the way to a full colour,
- intensity: similar to lightness,
- luminance: scale used on the CIE neutral axis.

## 6. CONCLUDING REMARKS

A short review has been given of a number of problems in the surround of activities in photogrammetry and remote sensing which deserve increased attention. The review has been prepared in a rather short time as a result of urgent other work commitments and can therefore not be as complete as was desired.

The review of activities of concern ongoing elsewhere shows that the shift in ISPRS activities towards the use of more digital images and of space images requires an increase in the monitoring of or even active participation irrelevant activities outside of ISPRS. As ISPRS has also a tradition in attempting a certain degree of standardization through the acceptance of recommended procedures but no mechanism to assure their up-to-datedness, the author **recommends** that ISPRS

- become more actively involved in ISO activities of direct interest and provide limited financial support to one or several liaison officers appointed by the society,
- look into the ramifications of quality management and quality control for its members,
- seek affiliate status in the CEOS and then actively participate in the work of those subgroups dealing with subjects of interest to ISPRS members,
- explore the need to deal with colour order systems.

These recommendations are based on the author's involvement primarily with the activities of ISPRS's TC I. It can be presumed that similar experiences regarding the scientific surrounding have been made within the context of the other Technical Commissions and it may therefore be appropriate to look at the problems of standardization from a global society point-of-view, for example by forming a respective working group under TC VI to possibly co-ordinate activities taking place in presumably most of the TC's of ISPRS.

## 7. REFERENCES

The information presented here has been gathered largely from unpublished working documents of the CEOS WGCV, from various documents of ISO and DIN (German Standards Institute) and from as yet unpublished manuscripts prepared for a ISPRS WG I/1 workshop held a year ago in Dessau, Germany.