

G03H

HOLOGRAPHIC PROCESSES OR APPARATUS (holograms, e.g. point holograms, used as ordinary optical elements [G02B 5/32](#); producing stereoscopic or other three-dimensional effects [G02B 27/22](#); diffraction-grating systems [G02B 27/44](#); systems using moiré fringes [G02B 27/60](#); optical logic elements [G02F 3/00](#); stereo-photography [G03B 35/00](#); photosensitive materials or processes for photographic purposes [G03C](#); {stereo-photographic or similar processes [G03C 9/00](#)}; apparatus for processing exposed photographic materials [G03D](#); analogue computers performing mathematical operations with the aid of optical elements [G06E 3/00](#); authentication by radiation, of concealed information carried by holograms or diffraction gratings [G06K 19/16](#); holographic storage [G11B 7/0065](#), [G11C 13/04](#); {stereoscopic or other three dimensional effects in television systems [H04N 13/00](#)})

Definition statement

This place covers:

- Means for and process of producing a numerical or analogical record of the phase and amplitude information of an object wave-front, e.g. by recording the interference pattern between a reference wavefront and the object wavefront;
- Hologram produced by the above process;
- Means for and process of reconstructing a holobject wave-front by optical or numerical diffraction from a hologram.
- The three main groups [G03H 1/00](#), [G03H 3/00](#), [G03H 5/00](#) relate each to different kind of waves : visible and near visible waves in [G03H 1/00](#); acoustic waves in [G03H 3/00](#) and other waves in [G03H 5/00](#);

Main groups [G03H 3/00](#) and [G03H 5/00](#) are considered as marker for tagging the wave used, whatever the wave, detailed classes are given under subgroups of [G03H 1/00](#).

- The large majority of application being limited to the field of optical holography, applications of holography are classified under [G03H 1/00](#).

Relationships with other classification places

Holography is a basic technology which developed in numerous application areas. A primary advantage of processing phase and amplitude information of an object wavefront is the ability of holography to reconstruct a 3D holobject from a recorded 3D object.

Whatever the application, [G03H](#) classification symbols are given for remaining pertinent holographic aspects.

References

Application-oriented references

Examples of places where the subject matter of this place is covered when specially adapted, used for a particular purpose, or incorporated in a larger system:

in lithography systems	B23K 26/06 , G03F 7/70283
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for authentication and security as covert or overt features	B41M 3/14 , B42D 25/29 , B42D 25/328 , B44F 1/10 , B65D 55/026 , D21F 1/44 , D21H 21/40 , G06K 7/10 , G06K 9/20 , G06K 19/16 , G07D 7/0032 , G09C 5/00 , H04K 1/00 , H04L 9/00 , H04L 29/00
in advertising, decorative arts	B44F 1/00 , B44F 7/00 , E01F 9/00 , G09F 13/02 , G03F13/04 , G09F 19/00
for recording or reconstructing three dimensional information	B44F 7/00 , G02B 27/22
in interferometry systems	G01B 9/021 , G01B 11/162 , G01M 17/027 , G01N 21/453
for metrology	G01B 11/00 , G01N 21/453
in alignment or positioning systems	G01B 11/02 , G01D 5/38 , G03F 9/00
for particle velocimetry	G01N 15/0227 , G01P 5/001 , G01P 5/26
restoring distorted objects	G01N 21/4795
in acousto-photonic systems	G01N 29/0663
as holographic diffractive optical elements	G02B 5/32
for routing	G02B 6/4204 , H04Q 3/526
in microscopy systems	G02B 21/00
in manipulation systems. e.g. Holographic tweezer	G02B 21/32 , G21K 1/00 , H05H 3/04
in scanner systems	G02B 26/106 , G06K 7/10663
as holographic optical element in head up displays	G02B 27/0103 , G02B 27/0172
for information processing	G02F 3/00 , G06E 3/001 , G06N 3/067
in haptic computer interfaces	G06F 3/011
in correlator systems	G06K 9/76
in holographic storage systems	G11B 7/0065 , G11C 13/042
in video-holography	H04N 5/89

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

2D	Two dimensional
3D	Three dimensional

Holobject	Object issued from the wavefront diffractively reconstructed (to be opposed to the object generating the wavefront holographically recorded)
Parallactic	Related to parallax e.g. parallactic decomposition stands for : decomposition of a 3D object into a set of 2D pictures obtained with various recording angle or line of sight

Synonyms and Keywords

In patent documents, the following abbreviations are often used:

CGH	Computer Generated Hologram
HOT	Holographic Optical Tweezer
SLM	Spatial Light Modulator

G03H 1/00

Holographic processes or apparatus using light, infra-red or ultra-violet waves for obtaining holograms or for obtaining an image from them; Details peculiar thereto

Definition statement

This place covers:

Holography using optical waves i.e. electromagnetic radiations within the range of visible or near to visible (i.e. infra-red, ultra-violet);

Applications wherein holography is an appropriate solution to a particular problem;

Systems for obtaining speckle reduction at recording or reconstruction; also applies to speckle reduction involved in numerical holography;

Systems for reducing the "space" x "spatial bandwidth" product; wherein the "space" measures the size of the hologram, the "spatial bandwidth" measures the "density" of holographic element, and the product reflects the total number of holographic elements forming the hologram; example : "horizontal parallax only" holograms comprise quasi-1D pertinent holographic information.

References

Limiting references

This place does not cover:

Interferometers using holographic techniques	G01B 9/021
Holograms used as optical elements	G02B 5/32
Holographic scanners	G02B 26/106
Holographic optical element in head up displays	G02B 27/0103
Arrangements for recognition printed or written characters using holographic masks	G06K 9/76
Recording, reproducing or erasing by using optical interference patterns, e.g. holograms	G11B 7/0065 , G11C 13/042

Informative references

Attention is drawn to the following places, which may be of interest for search:

Shaping the laser beam for laser beam working	B23K 26/06
Security printing	B41M 3/14
Security printed matter on banknotes	B42D 25/29
Information-bearing cards with holograms	B42D 25/328
Designs or pictures characterised by special or unusual light effects	B44F 1/00
Secret pictures	B44F 1/00
Designs imitating three-dimensional effects	B44F 7/00
Cleaning vehicle's windows using holographic sensor	B60S 1/084
Container closure with temper indication	B65D 55/026
Watermarking on paper	D21F 1/44
Security element added to paper	D21H 21/40
Arrangement of road signs or traffic signals	E01F 9/00
Refractor for light source using hologram	F21V 5/002
Measuring arrangements using optical means	G01B 11/00
Measuring deformation in a solid by holographic interferometry	G01B 11/164
Sensing comprising diffraction grating	G01D 5/38
Testing tyres using holography	G01M 17/027
Holography used to investigate particles	G01N 15/0205
Holographic interferometry used to investigate materials	G01N 21/453
Investigating or analysing materials by optical diffraction	G01N 21/4788
Spatially resolving object in scattering medium	G01N 21/4795
Flow measurement of fluid	G01P 5/001 , G01P 5/26
Diffraction gratings	G02B 5/18
Coupling light guides with holograms	G02B 6/4204
Microscopes	G02B 21/00
Micromanipulators structurally combined with microscopes	G02B 21/32
Systems for producing stereoscopic or 3D effects	G02B 27/22
Diffraction optics	G02B 27/42
Systems using moiré fringes	G02B 27/60
Optical logic element	G02F 3/00
Imaging mask onto workpiece in microlithography	G03F 7/70283
Registration or positioning	G03F 9/00
Analogue computers performing mathematical operations with the aid of optical elements	G06E 3/00
Haptic computer interface	G06F 3/011
Optical sensing of record carrier using holographic scanner	G06K 7/10663
image acquisition of printed or written character or pattern	G06K 9/20
Machine authentication of record carrier comprising hologram marking	G06K 19/16

Testing holographic security marking	G07D 7/0032
Ciphering of e.g. graphic data	G09C 5/00
Luminous advertising illuminated in front of the insignia	G09F 13/02
Luminous advertising illuminated behind the insignia	G09F 13/04
Miscellaneous advertising or display means	G09F 19/00
Arrangements for handling particles	G21K 1/00
secret communication	H04K 1/00 , H04L 9/00
Television using holographic recording	H04N 5/89
Optical switching systems	H04Q 3/526
micromanipulation of neutral particle beams	H05H 3/04

Special rules of classification

Holographic optical elements (HOEs, DOEs) are particular holograms wherein the holobject is a simple optical function (e.g. lens, mirror). Per se, HOEs are classified in [G02B 5/32](#), however, their production is classified under [G03H 1/04](#) (analogical record) or [G03H 1/08](#) (digital record).

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

Hologrametry	Dimensional and /or index measurement performed on the (optically or numerically) reconstructed holobject
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Synonyms and Keywords

In patent documents, the following abbreviations are often used:

DOE	Diffractive Optical Element
HDG	Holographic Diffraction Grating
HOE	Holographic Optical Element
HPO	Horizontal parallax only

G03H 1/02

Details {of features involved during the holographic process; Replication of holograms without interference recording}

Definition statement

This place covers:

- Isolated features involved during the holographic process (recording or reconstruction):

Recording material adapted to record holographic information :

organic material (e.g. Photopolymer, dichromated gelatine, Photoresists, Silver halide);

inorganic material (e.g. photorefractive crystal)

other recording means (e.g. CCD);

Details associated with the holographic record :

physical distribution storing in the hologram a print of the recorded interference pattern (variations of size, density, strength, charge, ...);

physical parameter affected when a reconstruction wave interacts with the hologram (amplitude, phase or polarization variations);

nature of the holographic medium (e.g. thin, thick, volume holograms); dynamic of the variations (binary, discrete, continuous);

ageing and resistance of the material;

non uniform thickness;

compound included into actinic material;

Mechanical aspect when related to holograms :

production line;

portable or mobile device;

moving component;

Involving specific optical component

phase mask; Diffuser;

optical filter;

amplitude, phase, or colour filter

particular location (e.g. in Fourier, holobject or image plane)

SLM as specific optical component

amplitude , signed amplitude , phase, polarization, complex , amplitude/phase coupled or colour modulation;

EASLM, OASLM, XASLM, Acousto-optic modulator;

having movable pixels

1D, 2D, 3D modulation;

multiple SLMs (e.g for multicolour processing):

having optical element in registration;

Object types :

diffusing, translucent and phase object;

2D (e.g. 2D SLM), 3D (e.g. 2D/3D) object;

holographic object

moving, coloured object;

numerical object (e.g. computer modeled or digitized real object);

decomposed object (e.g. 2D parallax decomposition);

Laminate comprising hologram :

special arrangement of layers (e.g. printed layer);

functional layer (e.g. antireflective, colour tuning, enhancement, colour active, protective layer, polarization, opaque or reflective layer);

Substrate aspect :

integrated surface relief hologram;

shape of the substrate (e.g. disc, ribbon, non planar shapes)

kind of substrate (flexible, fibrous, metallic, plastic, crystalline or glass substrate);

Patterned hologram;

Light characteristics;

- Surface relief holograms ;
- Copying holograms without interference recording, including embossing, moulding, casting, electroplating, masking.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Material deformation using laser beam	B23K 26/00
Moulds with particular shape of the moulding surface	B29C 33/42
Moulding article	B29C 37/0053
Injection moulding	B29C 45/00
Layered product	B32B 27/00 , B32B31/00 , B32B 33/00
Embossing decorations or marks	B44B 5/00
Pressing or stamping ornamental designs on surfaces	B44C 1/24
Manufacturing diffraction gratings using mechanical means	G02B 5/1852
SLM having movable pixels	G02B 26/0808 , G02B 26/0825 , G02B 26/0833
Photorefractive material per se	G02F 1/0338 , G02F 1/0541
Electro-optic SLM	G02F 1/05 , G02F 1/13
Optically addressed SLM	G02F 1/133362
Holographic polymer dispersed liquid crystals	G02F 1/13342
Photographic contact printing apparatus	G03B 27/02
Photosensitive recording materials per se	G03C 1/00 , G03C 5/00 , G03C 7/00 , G03C 8/00
Package for films	G03C 3/00
Dichromated gelatine for photolithography	G03C 5/22 , G03F 7/04
Bleaching	G03C 5/44
Preparation of phase shift mask	G03F 1/0046
Photoresist material for photolithography	G03F 7/00

Photopolymer material for photolithography	G03F 7/001
Recording members for recording by exposure	G03G 5/00
SLM for holographic storage	G11B 7/128
Inorganic recording material per se	G11B 7/243
Photopolymer material for holographic storage	G11B 7/245
Producing master for CD/DVD	G11B 7/261
Magneto-optical recording material per se	G11C 13/043
Photorefractive, electro-optical recording material per se	G11C 13/044
Photochromic recording material per se	G11C 13/045
Other recording material per se	G11C 13/046
Lasers	H01S 3/00

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

2D/3D object	Object formed of a stack of parallel 2D cross-sections of the object with a set of parallel 2D planes
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Synonyms and Keywords

In patent documents, the following abbreviations are often used:

EASLM	Electrically addressed SLM
LCD	Liquid Crystal Display
OASLM	Optically addressed SLM
SLM	Spatial Light Modulator

G03H 1/04

Processes or apparatus for producing holograms ([G03H 1/26](#) takes precedence)

Definition statement

This place covers:

- Optical recording geometry : in-line, off-axis, non-orthogonal; transmission or reflection; image plane, Fourier transform, Lippmann;
- Recording arrangement involving particular optical element (e.g. a diffuser for recording coded-beam hologram); particular beam shape or geometry;
- Recording arrangement adapted to compensate or suppress aberration, distortions or unwanted interference fringes ;
- Recording arrangement adapted to record HOE;
- Coded beam holography (wherein at least one of the object and reference beams is optically coded (e.g. with a diffuser) during recording);
- Coherence gated holography;
- Polarization preserving holography;
- Pseudo-deep holography;

- Total internal reflection, waveguide, substrate-mode holography;
- Harmonic holography;
- Monitoring the hologram formation;

Particular processing of hologram record carrier, including

- pre-exposure processing e.g. hypersensitization, partial deactivation, trimming;
- Post-exposure processing including
- chemical processing e.g. latensification, bleaching, fixing, trimming;
- physical processing e.g. shaping, delaminating, de-metalization;
- fringe deformation (swelling or shrinking processes) e.g. for tuning reconstruction wavelength or measuring substrate deformation;
- erasing the holographic information, including coherent erasure by superimposing pi shifted information;

Copying holograms by holographic means including :

- Contact copy
- Copying wherein the H1 and H2 holograms are separated such that the reference beam exposing the H2 does not interact with the H1;
- Copying using conjugate waves;
- Copying with category transfer;
- Subdivided copy.

References

Limiting references

This place does not cover:

Processes or apparatus specially adapted to produce multiple holograms	G03H 1/26
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Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

H1/H2 process	Transferring holographic information from master H1 to recording material H2
TIR	Total Internal Reflection

G03H 1/08

Synthesising holograms, {i.e. holograms synthesized from objects or objects from holograms} (using electric digital computers [G06F](#); [G06T](#))

Definition statement

This place covers:

- Holograms synthesized from objects or objects from holograms.

In this sub-group, a digital representation of the hologram is mandatory.

- Hologram synthesis per se, comprising a numerical transform simulating light propagation (e.g. Fresnel or Fourier transforms) between object and hologram domains (for Computer Generated Hologram, CGH) or between holographic data and holobject (in digital holography).

- The main processing steps that may be involved are:

- Numerical processing of object including object description such as geometrical, parallax decomposition, slicing, rendering;
- Methods of numerical synthesis including Fresnel and Fourier transforms,
- convolution and iterative algorithm (e.g. IFTA), direct design (e.g. DBS, simulated annealing), Diffraction specific, Coherent ray tracing ;
- Numerical processing in hologram domain including noise reduction, linear
- combination of holograms, numerical padding;
- Encoding aspect including cell or point oriented coding, amplitude, phase or
- complex encoding, quantization;
- Synthesis adapted to generate holographic optical element;
- Synthesis adapted to generate holobjects from hologram, including solving phase ambiguity (phase unwrapping), recovering complex amplitude in hologram plane (using phase shifting, spatial heterodyning), synthetic aperturing;
- Adapted hardware (for computation or transmission);
- Materializing the synthetic hologram including serial or parallel printing, forming amplitude, phase or complex transmittance .

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Digital computing or data processing, specially adapted for specific functions or applications	G06F 17/00 , G06F 19/00
General purpose image data processing	G06T 1/00
Data description and modelling of 3D objects	G06T 15/00 , G06T 17/00

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

Digital holography	digital recording of holograms and subsequent numerical processing
Complex hologram	CGH encoding amplitude and phase (i.e. complex values : Amplitude $\exp(i \text{ phase})$)
Gerchberg - Saxton algorithm	a IFTA algorithm
Kinoform	CGH encoding phase only

Synonyms and Keywords

In patent documents, the following abbreviations are often used:

CGH	Computer Generated Hologram
DBS	Direct Binary Search
IFTA	Iterative Fourier Transform Algorithm

G03H 1/22

Processes or apparatus for obtaining an optical image from holograms ([G03H 1/26](#) - [G03H 1/34](#) take precedence)

Definition statement

This place covers:

Processes or apparatus for obtaining a holobject from an analogical or numerical hologram;

Particular reconstruction arrangement including :

- Mechanical support holding the holographic record;
- Optical arrangement and orientation between light source, hologram and detector (e.g. transmission reflection or edge lit reconstruction);
- Eliminating certain diffraction orders;
- Downstream optical component (e.g. diffusing surface revealing the holobject);
- Particular reconstruction light (white light [G03H 1/24](#));

Dynamic of the holobject

- static;
- pseudo-dynamic wherein a dynamic effect is produced from a single hologram;
- dynamic wherein a time varying sequence of holograms is displayed;
- dynamic wherein a time varying sequence of holographic fringes information is addressed to a SLM;

Particular holobject including 2D, 3D, 2D+3D holobjects, rescaled or polarized holobjects;

Superposing or matching the holobject with other visual information;

Holobject having particular colour including achromatic, RGB, rainbow-like;

Particular location of the holobject with respect to the hologram, including in-plane, real, virtual or straddling holobject.

References

Limiting references

This place does not cover:

Processes or apparatus specially adapted to reconstruct holobject(s) from multiple holograms	G03H 1/26
Systems for obtaining speckle elimination	G03H 1/32
Systems for reducing the space-spatial bandwidth product	G03H 1/34

Informative references

Attention is drawn to the following places, which may be of interest for search:

Grating image	G02B 5/1842
Stereoscopic microscopes	G02B 21/22
Systems for producing stereoscopic or 3D effects	G02B 27/22
Stereoscopic photography	G03B 35/00
Stereo photographic or similar process	G03C 9/00

Display per se	G09F 19/00
Stereoscopic television system	H04N 13/00

Special rules of classification

Details and isolated features involved during the reconstruction process are also classified under [G03H 1/02](#).

G03H 1/26

Processes or apparatus specially adapted to produce multiple {sub-} holograms or to obtain images from them, e.g. multicolour technique

Definition statement

This place covers:

- Angle multiplexing (multichannel holography);
- Coherence multiplexing wherein different holobjects are perceived under incoherent and coherent illumination;
- Phase code multiplexing ;
- Polarization multiplexing;
- Temporal multiplexing :

Frame or time sequential multiplexing wherein a plurality of sub-holograms or holographic sub-frames are time multiplexed to reconstruct one holobject;

Double or multiple exposure recording process;

- Superimposed holograms ([G03H 1/28](#)) wherein the sub-holograms are superimposed in the same recording layer;
- Spatial multiplexing ([G03H 1/30](#)) wherein the sub-holograms are spatially multiplexed in a single material layer; including:

in-plane or depth multiplexing;

shape of the sub-hologram;

interleaved sub-holograms;

tiled identical holograms;

dot matrix holograms;

- Holographic stereogram wherein a collection of parallaxic 2D pictures views of a 3D object are multiplexed into a holographic record thereby allowing to reconstruct the 3D holobject due to stereoscopic perception;

one steps and two steps holographic stereograms;

- Arrangement comprising multiple holograms in spatially separated supports

mechanically separated or in contact;

optically separated or in contact (optical contact in the sense that a reconstruction beam crosses the holograms);

made of different materials;

for spectral broadening (e.g. multicolour holobject);

comprising a HOE;

mixed volume/surface hologram;

superposed surface relief;

References

Limiting references

This place does not cover:

Stacked holographic layers	G03H 1/26
Double exposure interferometry	G01B 9/025

Special rules of classification

Details of the recording/reconstruction arrangement are also classified in respective classes in [G03H 1/00](#).

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

Multichannel holography	Angle multiplexed holography wherein the holobject change when orientation varies
Holographic stereogram	Hologram multiplexing a collection of parallaxic (2D) pictures views of a (3D) object; replays 3D holobject

G03H 3/00

Holographic processes or apparatus using ultrasonic, sonic or infrasonic waves for obtaining holograms; Processes or apparatus for obtaining an optical image from them ([G03H 1/22](#) takes precedence; {acoustic non-destructive testing using holographic methods [G01N 29/0663](#); seismology using acoustic vibrations [G01V 1/00](#); non-holographic methods for visualizing acoustic waves [G10K 15/00](#)})

References

Limiting references

This place does not cover:

Details of holographic recording and reconstruction process	G03H 1/00
Acousto-photonic imaging	G01N 29/0663

Informative references

Attention is drawn to the following places, which may be of interest for search:

Non destructive holographic visualisation and testing	G01N 29/0663
Seismic or acoustic prospecting or detecting	G01V 1/00
Producing, transmitting, directing, suppressing sound waves	G10K

G03H 5/00

Holographic processes or apparatus using particles or using waves other than those covered by groups [G03H 1/00](#) or [G03H 3/00](#) for obtaining holograms; Processes or apparatus for obtaining an optical image from them ([G03H 1/22](#) takes precedence; construction of electron microscopes [H01J 37/26](#); {investigating or analysing materials by the use of microwaves [G01N 22/00](#), by the use of particles wave or X-rays [G01N 23/00](#), [G21K 7/00](#)})

References

Limiting references

This place does not cover:

Details of holographic recording and reconstruction process	G03H 1/00
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Informative references

Attention is drawn to the following places, which may be of interest for search:

Investigating or analysing materials by the use of microwaves	G01N 22/00
Investigating and forming a picture of materials by the use of other wave or particle radiation e.g. X-rays or electron or neutrons	G01N 23/04
Investigating and forming a picture of materials by the use of nuclear magnetic resonance, electron paramagnetic resonance or other spin effects	G01N24/04
Gamma- or X-ray microscopes	G21K 7/00
Electron microscope	H01J 37/26