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Chapter 1 : Practical Holography, Fourth Edition Download

Manual of Practical Holography Graham Saxby. Contents Preface xiii 1 Images with depth 1 The uses of holograms 2 2 How a hologram works 4.

Hologram Background A hologram is a flat surface that, under proper illumination, appears to contain a three-dimensional image. A hologram may also project a three-dimensional image into the airâ€”a lifelike image that can be photographed although it cannot be touched. The word hologram comes from the Greek roots holos meaning whole and gramma meaning message. The process of making a hologram is called holography. When a hologram is made, light from a laser records an image of the desired object on film or a photographic plate. There are basically two types of holograms. A reflection hologram is viewed when lit from the front, while a transmission hologram is viewed by shining a light through it from the back side. An embossed hologram is made by backing a transmission hologram with a mirror-like substance, which allows it to be viewed when lit from the front. Holograms can also be made that show moving objects; these sequences, called stereograms, are typically three to 20 seconds long. Although a hologram is a visual image of a physical object, it is quite different from a photograph. For instance, when an object is photographed, each portion of the photo contains an image of the corresponding portion of the original object. Thus, if the transparent plate containing a transmission hologram is broken, each piece will still be able to project the entire image, albeit from a different point of view. Using a piece from near the top of the holographic plate will produce an image as seen from above, while using a piece from near the bottom of the plate will create the impression of looking upward toward the object. Another interesting property of holograms is that they preserve the optical properties of objects such as lenses. For instance, consider making a hologram of a magnifying glass placed in front of a butterfly. When viewing the holographic image of those objects, an observer will find that the portions of the butterfly seen through the image of the magnifying glass will be enlarged. Holographic packaging has been shown to increase the sales of certain products. Projection holograms are especially eye-catching and are used at trade shows and retail stores. They can be used to display extremely delicate or valuable objects. A classic example was an image of a diamond-adorned hand that was projected over the sidewalk outside the Cartier jewelry store in New York City in Not only did it catch the attention of people walking by it, it attracted television news crews. In fact, it was even attacked by an umbrella-wielding pedestrian who thought it was the "work of the devil. As yet another application of holography, former Chicago Bears football coach Mike Ditka displayed a holographic portrait of himself in his restaurant to create a somewhat personal image when he could not be there in person. Holograms can be made at home by hobbyists for a modest investment in equipment. The process requires a laser and an isolation table to prevent movement of the equipment while the film is being exposed. Holograms are also produced commercially and can be reproduced in large quantities. Reproducing the image costs from 1 to 4 cents per inch 2. Finished holograms can be attached to other objects as pressure-sensitive labels 0. Once the artwork is finalized, it takes about three months to create and reproduce a batch of commercial holograms. History The first hologram was made in by Dennis Gabor , a Hungarian-born scientist who was working at the Imperial College of London. Gabor was attempting to refine the design of an electron microscope. He devised a new technique, which he decided to test with a filtered light beam before trying it with an electron beam. Gabor made a transmission hologram by carefully filtering his light source, but the process did not become practical until technology provided a way to produce coherent lightâ€”light that consists of a single frequency and a single wavelength. Hologram production took off with the invention of the laser in , as a laser generates light that is of a single color frequency and produces waves that travel in phase with one another. The image was clear and three-dimensional, but it could only be viewed by illuminating it with a laser. That same year Uri N. Denisyuk of the Soviet Union produced a reflection hologram that could be viewed with light from an ordinary bulb. A further advance came in when Stephen A. Benton created the first transmission hologram that could be viewed in ordinary light. This led to the development of embossed holograms, making it possible to mass produce holograms for common use. Nearly a quarter century after he had made the first hologram, Gabor was

awarded the Nobel Prize for Physics for this achievement in The following year, Lloyd Cross made the first recording of a moving hologram by imprinting sequential frames from ordinary moving picture film onto holographic film. Raw Materials Holograms made by individuals are usually exposed on very high resolution photographic film coated with a silver halide emulsion. Holograms made for mass production are exposed on a glass plate pretreated with iron oxide and then coated with photoresist. The photoresist material will chemically react to the specific wavelength of light that will be used to create the hologram. Because of their availability at a relatively low cost, helium-neon lasers are most commonly used by individuals who make their own holograms. Commercial hologram manufacturers use different laser types such as ruby, helium-cadmium, or krypton-argon ion. After exposure, the film or photoresist plate is processed in chemical developers like those used in photography. Both nickel and silver are used to make the production masters that will be used to stamp multiple copies of the holograms onto polyester or polypropylene film. Aluminum is used to create the reflective coating on the back of embossed holograms. Design A three-dimensional, physical object can be used to create a hologram. The holographic image is normally the same size as the original object. This may require construction of a detailed scale model of the actual subject in a size suitable for the holographic image. Altematively, the artwork that is to be reproduced as a hologram can be computer generated, in which case software controls the laser exposure of the image file, one pixel at a time. Pixels are the individual dots that comprise a graphic image on a computer screen or printout. The Manufacturing Process Various manuals are available that explain to amateur holographers how to make holograms at home. The following steps describe the commercial mass production of a holographic image of an actual, three-dimensional object. Mastering 1 A laser is used to illuminate the physical object, with the reflected light falling on the photoresist plate. Simultaneously, a reference beam from the laser also falls directly on the photoresist plate. The interference patterns of these two light beams react with the photo-sensitive coating to record a holographic image of the object. Common exposure times are between one to 60 seconds. In photography, slight motion of the object or the film results in a blurred image. In holography, however, the exposed plate will be blank contain no image at all if during the exposure there is movement as small as one fourth the wavelength of the laser light wavelengths of visible light range from to billionths of a meter. A typical photoresist plate has a 6 in Because many holograms are smaller than this, several different images can be "ganged" clustered onto one plate, just as numerous individual photographs are exposed on one roll of film. After being exposed, the master is processed in a chemical bath using standard photographic developers. Before proceeding with production, the master is inspected to confirm that the image has been properly recorded. Electroforming 3 The master is mounted into a jig frame and sprayed with silver paint to achieve good electrical conductivity. The jig is lowered into a tank along with a supply of nickel. An electric current is introduced, and the master is electroplated with nickel. The jig is removed from the tank and washed with deionized water. The thin, nickel coating, which is called the metal master shim, is peeled off the master plate. It contains a negative image of the master hologram the negative is actually a mirror image of the original hologram. Using similar processes, several generations of shims are created. Those made from the metal master shim are known as "grandmothers," and they contain positive images of the original hologram. At this stage, numerous copies of the original image are "combined" duplicated in rows on one shim that can be used to print multiple copies with a single impression. Successive generations of shims are known as "mothers," "daughters," and "stamper shims. Embossing 4 Stamper shims are mounted in embossing machines. A roll of polyester film or a similar material that has been smoothed with an acrylic coating is run through the machine. Under intense heat and pressure, the shim presses the holographic image onto the film, to a depth of 25 millionths of a millimeter. The embossed film is rewound onto a roll. Metallizing 5 The roll of embossed film is loaded into a chamber from which the air is removed to create a vacuum. The sheet is exposed to the vaporized aluminum as it is rewound onto another roll, and in the process it becomes coated with aluminum. After being removed from the vacuum chamber, the film is treated to restore moisture lost under the hot vacuum condition. A top coating of lacquer is applied to the film to create a surface that can be imprinted with ink. The roll of film, which may be as wide as 92 in 2. Converting 6 Depending on what type of film was used and what kind of product is being made, one or more finishing steps may be done. For instance, the film may

be laminated to paper board to give it strength. The film is also cut into shapes desired for the final product and may be printed with messages. Heat-sensitive or pressure-sensitive adhesive is applied to the back of holograms that will be affixed to other objects or used as stickers. Finishing 7 The holograms are either attached to other products or are counted and packaged for shipment. The Future Today, the most common use of holograms is in consumer products and advertising materials. There are some unusual applications too. For example, in some military aircraft, pilots can read their instruments while looking through the windshield by using a holographic display projected in front of their eyes. Automobile manufacturers are considering similar displays for their cars. Holograms can be created without visible light. Ultraviolet, x-ray, and sound waves can all be used to create them. Microwave holography is being used in astronomy to record radio waves from deep space. Holograms made with short waves such as x rays can create images of particles as small as molecules and atoms.

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Chapter 2 : Readings | Holographic Imaging | Media Arts and Sciences | MIT OpenCourseWare

*The Manual of Practical Holography [Graham Saxby] on calendrierdelascience.com *FREE* shipping on qualifying offers.*

Reviews Summary Revised to reflect technological advances and new applications, Practical Holography, Third Edition is a classic, comprehensive text suitable for anyone involved in holography, from the interested amateur to the practicing research scientist. At its most basic level, the book introduces the principles behind holography and takes the reader on a step-by-step course through the materials, equipment, and techniques required to produce their own holograms. The author takes a purely practical viewpoint, keeping the mathematical content to a minimum. Later chapters of the book form a valuable reference for research scientists working with holographic techniques in all applications. Table of Contents Stereoscopy, interference and diffraction. Light sources for holography. The basic types of hologram. Materials, exposure and processing. Building a holographic laboratory. Master holograms on a table. Holograms including focusing optics. Portraiture and pulse laser holography. Holography in natural colours. Achromatic and pseudocolor holograms. Non-silver precesses in holography. Data storage and diffractive elements. Holography in biology and medicine. Other applications of holography. He takes the reader through what a hologram is, the history of holography, what sort of light sources can be used to make a hologram, what kinds have been made to date, and so on through to making and displaying your own images. The book is written in a clear concise manner and is augmented by additional tips, definitions, and observations in the margins as well as extensive source references at the end of each chapter. There is no other book that can remotely compete with it. Jeong, Integraf "Most books on holography fit into one of two main forms: Thankfully Practical Holography does not fit in to either of these categories but covers both without being either patronising or overwhelming to the interested beginner or too lacking in detail and undemanding for the professional. I have used previous editions at levels ranging from short one-day introductory courses through to M. It is as up to date as any technical book can be and covers all aspects of holography in great detail from its inception to the present and offers some intriguing glimpses into the possible future of the medium â€¦ The text is concise and the diagrams clear and wide ranging; layout and approach, in the parlance of computer terminology, is user friendly and it is easy to find a personalised route to suit all, from the interested amateur to the professional holographer â€¦ For the serious holographer and any college library it is essential. From designing table layouts and making recording materials to designing and making your own optics, and building an optical table, Graham covers everything an aspiring holographer would want to know. With his experience with both professional and amateur holographers he is able to provide many different approaches to a problem, allowing the reader to decide which solution fits his needs, skills, and budget. This much awaited update was well worth the wait. It will be the bible for at least another 10 years and anyone who actually is making or wants to make holograms will find it indispensable. Taking into consideration the possible savings on equipment and raw materials, and potential time wasted, this comprehensive and extremely informative book will no doubt pay for itself in a very short time indeed, and I can strongly recommend it. Considering the importance of holography in many different fields, it is almost a scandal that there are so few books on the subject and it is very reassuring to see that the author has gone to the effort to do a new edition, which I hope will be successful.

Chapter 3 : Graham Sasby (Author of The Manual Of Practical Holography)

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This page contains a complete list of reading material for MAS. It also includes all of the bibliographic information for all readings. Introduction Although holography was invented more than 50 years ago, and entered its modern laser age about 35 years ago, it remains an infant and struggling medium, and its literature is correspondingly scattered and often hard to find. This course will depend mainly on readings from draft chapters of Prof. However, there are many things left to learn in the literature. Many of the items listed here are available at various libraries at MIT, and catalog numbers will gradually join this list bring in those you dig out, too. Some of the other books can be examined at the Spatial Imaging Laboratory although not checked out. Accumulating your own library will be slow because many of these volumes were produced in small numbers, and may now be out of print. We will appreciate any additions to this shopping list you may wish to recommend. Books that might be referred to in class are grouped first â€" the others are intended only as collateral reading suggestions. Much of the important original literature is in the archival journals, such as the Journal of the Optical Society of America, as well as in the Symposium Proceedings listed below. Most of the readings have extensive bibliographies, and a specialized list of journal references might be finished by the end of the term. Patents can also be an important source of information, but are not included here. Reflection Ray-tracing Reflection Holography: Off-axis Reflection Holography Reflection Holography: Optical Information Processing and Holography. This graduate level electrical engineering oriented text is much more mathematical than needed here, but it is comprehensive and interesting to read. This is the "bible" of holography, available in paperback, and contains sections on many topics still of interest to display holographers. It is somewhat dated nicely superseded by Hariharan , and invokes more math than we will use. Of the "physics for poets" genre. Highly interesting and simplified, but reasonably accurate, lots of pictures and almost no math! Introduction to Fourier Optics. The first, and still the foremost, text on the application of communication theory concepts to the analysis of coherent optical imaging systems graduate EE math level. The longest chapter is on holography. Cambridge University Press, UK, Paperback , 2nd Edition A very nice self-contained treatment of the principles, techniques, and application, tempered by a good sense of what really matters, and what really works. Hariharan has made also several important contributions to the science of holography. A very good all-round undergraduate text on optics. Includes a section on holography pre-rainbow. Theory and Problems of Optics. A concise survey of the wave-optical concepts involved in holography, with many example problems and solutions. Tab Books, Blue Ridge Summit, Introduction to Lasers and Their Applications. An undergraduate-level survey of laser technology with good explanations, including Chap. Manual of Practical Holography. Although most of the experimental hardware is idiosyncratic, the practical concepts are very well explained. A fairly thorough and well illustrated discussion of holography on the level of an advanced amateur preparing to undertake a serious hobby no math. Lots of collateral information, such as how to make your own optical elements. Very British in its style and humor. Unterseher, Hansen, and Schlesinger. A folksy and often humorous guide for the serious hobbyist. It has many practical tips and detailed layouts for the display holographer. Well leavened with California funk, it is the "whole-holography catalog. Handbook of Optical Holography. This collection of pieces contains widely differing styles and levels, many missing the goal of a truly useful handbook. Of particular interest will be: Topics in Applied Physics, no. Also of Interest Born, M. Pergamon Press, and later editions. THE reference for theoretical optics. Very tough sledding, even among professionals, but well worth a browsing or a search for definitive proofs if you have a taste for that sort of thing. This supplements the general discussions of chemical safety in the course. The Magic of Holography. Probably the book to send when your kid sister or brother asks "what IS holography? A Study Guide on Holography draft. Lake Forest College, July A marvelous collection of papers from across the spectrum of artistic, technical, research and related efforts. A

thicker volume than 1, and generally meatier papers. The next report of this important series of conferences. Holography Using a Helium-Neon Laser. An introductory guide for the small-scale laboratory equipment and second rate lasers made by Metrologic but interesting reading. A beautifully printed but overly compacted guide to simple holography setups, sponsored by the best known manufacturer of holographic hardware. How To Make Holograms. Blue Ridge Summit, PA: A real "how to build your own shop" narrative, well illustrated, in the "Popular Mechanics" tradition. PVC pipe optics holders in a sand table is the result, and they work. Nice interviews with holographers, and photos of their work. Readings from Scientific American. See also Leith, E. A model treatment of wave physical optics using nothing beyond "shop math" algebra, geometry and trigonometry. Occasionally cumbersome, but it covers the important physical phenomena. This is one of over 2, courses on OCW. Find materials for this course in the pages linked along the left. No enrollment or registration. Freely browse and use OCW materials at your own pace. Knowledge is your reward. Use OCW to guide your own life-long learning, or to teach others. Download files for later. Send to friends and colleagues. Modify, remix, and reuse just remember to cite OCW as the source.

Chapter 4 : Practical Holography - CRC Press Book

Manual of Practical Holography by Graham Saxby (review) Ron Graham Leonardo, Volume 26, Number 1, February , pp. (Review) Published by The MIT Press.

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