G^N xpert Neural Technologies

2224 W.Chicago Ave., Chicago IL 60622

(773) 370 5533, 370 5522, 278 1836, fax (773) 278 1837

info@gnxpert.com

1. Technology overview.

This technology description takes a view on a device that displays a motion holographic screen without glasses or other devises. It displays a full deep three-dimensional vision using optic holographic techniques with the latest invention based on artificial neural network. Out technology make real to develop a holographic television, holographic cinema, holographic microscope and telescope, holographic radar system and so on.

2. Holographic information

2.1. The main method of calculation and synthesis of motion holography based on Fourier discrete conversion. We use educated neural network processor for holographic algorithm execution that make possible to calculate a digit holography.

2.2. Volume of information in holographic object is very massive. For example, 100x100x100 mm cube with wave length 0.5 microns it produce $(2*e^5)^3 = 8*e^{15}$ pixels. We create an algorithm to reduce this information volume.

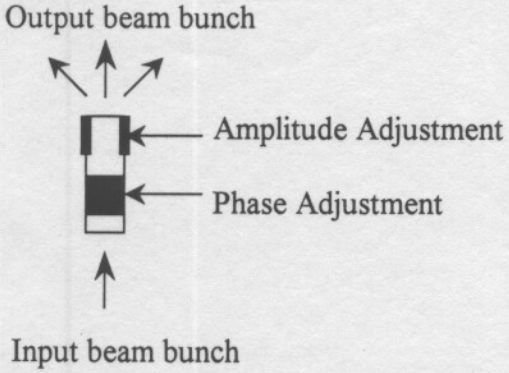
2.3. Optic output channel.

3. Optic output channel

3.1 Radiation system

This scheme has no base beam bunch and optic channel developed as a flat surface of radiating elements. Each element has separate adjustment of amplitude and phase of output bunch.

Each element represents the cylinder (or a rectangular) made of piezo material with covered on a surface (or galvanically produced) two pairs of facings that are developed (unwrapped) from each other along an optical axis on 90 degrees. By putting a voltage on one pair of facings the amplitude will be adjusted, and by putting a voltage on another pair of facings a phase of a target beam bunch will be adjusted (as shown below).



Adjustment element is separated to two parts because of the reasons of technological opportunities and possibilities or application of various optical materials for management of amplitude and a phase of a beam bunch.

Adjustment of amplitude is based on property of a degree changing of polarization of piezo material under influence of the applied voltage. Adjustment of a phase based on property of changing of the linear sizes or optical density of piezo material under influence of the applied voltage. From physics it is known, that speed of light in optic dense environments is less than speed of light in vacuum on the size of a refracting factor of material. Under influence of the applied voltage the length of light beam way is changes, so the phase of an output beam bunch is also changes according to input beam bunch (the optical density of a material changes). For adjustment of a phase there will be enough value equal to length of a wave.

The size of one element is very small, as far as allows making it technology of their manufacturing. All elements supplied by a beam bunch from one source of coherent radiation.

Input and output surface should be maximum plane as far as allows making it the technology of their manufacture. We expect a wave front from each unit because of not ideal plane that considerably will increase time of calculation of the hologram.

Here there are some ways out:

1. Develop the size of each element equal of light length ~ 0,5 … 1 microns
   Cover the output and input element surface with a layer of optically transparent material conterminous on refracted coefficient of piezo material. This material should be liquid in an initial state with its subsequent polymerization (liquids have ideally plain surface).
3. Holographic correction.

3.2. Reflecting system

In the reflective scheme the basic beam bunch of coherent radiation is applied. The surface of a reflective plane can be a membrane or curvature that under control of piezo elements (or film-forms). The Disadvantage of this scheme is an impossibility of handle amplitude of output beams bunches. During hologram calculation it is not possible to find satisfactory solution on to clear a plenty of interferences on the image map.

The way out could be possible to apply a two-layer construction, having applied in a upper layer for example LCD matrix to handle of amplitude.

3.4. Color

The first example required three sources of coherent radiation with base colors or the supplemented colors. For a supply of controlling units it is not necessary to put optical wave-guides that the beam bunch of radiation from the defined laser got on the defined unit. Optical wave-guides technological are difficult enough for making, in addition in wave-guides the interference of waves that will result in appearance in the channel of several waves with various phase shift and amplitude is possible. It is possible to lightening on control units al thee beam simultaneously:

3.4.1. To apply impulse lasers and to include them in turn with some speed of alternation. This variant will need lasers with the power enlarged in 3 times.

3.4.2. All three lasers are turned on simultaneously.

To divide beam bunches from lasers with various frequency and to route them on the defined controlling units, we develop a diffraction cell prism between lasers and controlling units. Controlling units allocate with bars, which parallel to strokes on the diffraction cell prism (or an optical axis of a prism). This scheme is attractive make it possible to apply usual lamps instead of lasers. But thus sizes of units should be small enough to not accept in controlling units of wave beam bunches from a various long wave (i.e. linear sizes should be equal to a wavelength ~ 0,4 … 0,7 microns)

3.5. Elimination of technological errors at manufacture of the optical channel

This task can be solved by calibration of the optical channel. For this purpose it is necessary to remove the phase and amplitude characteristic of each of units by Ung or Mikelson interferometer or by processing interferent picture from each of the units, obtained from a video camera or LCD matrixes with the subsequent correction of the values obtained at calculation under the table of calibration.

Elimination of technological errors at manufacture of the optical channel can be eliminated by holographic methods. It is possible to create holograms of many optical units with the accuracy inaccessible for mechanical or laser technologies. And these units will work the same as those who are made with optical materials (every possible lenses, prisms, diffraction cell prism or lattices and so on). It isalso possible to create the optical correcting unit with such characteristics and write its image map on reflective hologram.

3.6. Controlling of optical channel units

For controlling of optical channel units we use DAC chips with analogue multiplexers or circuits such as dynamic charging for storage units (the scheme of refreshing in dynamic memory)

4. Quantity of controlling units in a plane for getting holographic maps

4.1. The holograms obtained by a natural way have property at a partition on some parts and lighting in the further of these parts separately to receive the map from each of these parts which nothing differs from initial. At the further decrease of a size of the map loses visibility, and also fallout of some fragments of the map is possible. The holograms written by a natural way have as a rule the big redundancy of the information.

For the quantitative analysis of necessary amount of units of the optical channel for synthesis of the holographic map of the object it is necessary to analyze obtained synthesized harmonic series Fourier of this map on periodicity. The obtained value also will be required value of quantity of the units on the hologram for obtaining the given holographic map.

4.2. One of properties of holograms is that at lighting the hologram by a disperce beam bunch of coherent radiation the sizes of the visible holographic map are increased proportionally.

x=1+sin (a) where: **x** – Factor on sizes of the hologram;
a – Raster angel of a beam bunch;

On this principle the holographic microscope is constructed. By this method the increase in some tens and hundreds times can be achieved. One of such method is aberrations of the represented object. It is possible to compensate this disadvantage at the initial stage - by correction of geometrical characteristics of the given object.

4.3. The visible angular size of an ideal human eye makes 1 ' (1/60 degrees). Actually it is possible to take 1/20 degrees. On distance of 40 sm it is possible to distinguish 0,04 mm Total for a cube 100x100x100 mm it is received (100 / 0,04) 3 = 15*e9 pixels in size of the holographic map.
Size of calculations for construction of the digital hologram is very great. Accuracy will be necessary for each pixel of the hologram ~ 3 bytes on the value of a phase and as much on amplitude of a beam bunch. Total ~ 90 gigabytes.

4.3. Alternate solution. It is possible for output and calculation of the hologram cut the hologram on some parts (sizes or planes) and to output them in the optical channel in some sequence. This method will give a scoring in cost and simplification of the optical channel, but thus size of calculations as all the same it is necessary to count all pixels for each of output parts that there were no superfluous interferences at output of the map increases. A little scoring on speed and size of

calculations will give that the pixels not present in the given size (plane) is possible to calculate, setting some acceptable threshold of their luminosity (the higher it is > > the less calculations will be)

5. Artificial Neural Networks and holography

Neural networks and a holography have much in common. The holographic plate with the written information is very similar on trained neural network. On one plate, changing frequency and a corner of an inclination of a basic beam bunch it is possible to write hundreds and thousand maps. In addition holographic recordings with success are applied to a pattern recognition - if on a plate to route not a basic beam bunch, and wave front from the map - that on an output to appear an output beam bunch of radiation - measuring its intensity and frequency, it is possible to tell about a degree of reliability of the presented image with earlier written one. Or in a control plane appear bright points, intensity and which character of layout will give the information on finding in the presented fragments of the recognized maps. And speed of recognition is higher than in modern PCs.

As the task of calculation of the synthesized holograms already practically is solved, the following stage is real time output of holograms. An obstacle of real time holographic output is significant time of calculation of the holographic map even on the most powerful modern computers. The idea of neural network application for calculation of the holographic map is based on resembling a neural network and a holography. Training neural network there is a process of equilibration of coefficients of everyone neuron unit for some of entry signals for obtaining a "correct" output signal. Practically the same occurs at calculation of the holographic map - mathematical methods make calculations which counterbalance the value of amplitude and phase shift for each low level cell of the optical channel (link everyone with everyone – full connected neural network).

In the first layer it will be necessary to determine complex amplitude of light let out by it outgoing from the object in the plane which are taking place on defined distance from him(it). This plane will be a plane of the hologram (an output plane of the optical channel). On an input of units of the first layer the binary information on space coordinates and color / light characteristic of points of the object will act.

In the second layer equilibration of the value of a phase and amplitude for each unit on a plane of the optical channel of output will be made. Link between the first and second layer also should be complete as each unit of the optical channel participates in creation of all pixels of the map.

The third layer it is possible to be necessary for collection of the various statistical and debug information or correction of defects of technological manufacture or physical imperfection of the optical channel of output. Here it is possible to be necessary recurrent link with the second layer.