OPTICAL SYSTEM WITH A BRIGHTNESS AMPLIFIER FOR TV IMAGES

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Optical system is experimentally realized for projecting colored images onto a large screen. Optical data recorded with liquid crystal modulators is read by beams of amplified spontaneous radiation or by a laser beam.

The problem on creation of color devices, which could provide obtaining images of 10 m^2 and larger, is still an urgent problem now,[1,2] in spite of a known success in creating the devices for the data (TV images) mapping. One of the variants of constructing such a device could be based on the investigation of the system consisting of quantum amplifiers coupled with liquid-crystal spatiotemporal modulators of light (LCSTML) and, in particular, with STML with the metal-dielectric-semiconductor (MDS) structure.[3]

Just for simplicity, we use in this paper the principle of separate reconstruction of images by the color channels, with the subsequent accumulation on the common screen of observations.

In the experiments we used quantum amplifiers of brightness, which operated in red, green, and blue spectral ranges, based on Au, Cu, and Sr vapors, respectively. Principle of intracavity reading of the data was used in the latter case in order to obtain maximum parameters. Modern sealed-off active media of Au-vapor make it possible to obtain the radiation of several watts at the output of the optical system, and of tens of watts for the Cu-vapor laser medium. The size of the projection screen can be tens or hundreds of square meters, respectively. Average image power of 1 W is reached in the Sr-vapor active medium. As it was mentioned above, the multipass diagram of the image brightness amplification was used in this wavelength range. Then, as it was shown in Ref. 4, the images amplified can be different from the initial ones. Multiple reflection results, for example, in underlying of image parts. Additional causes of the distortions appear in the strong fields, when the saturation of amplification has been revealed. The nature and magnitude of distortions depend on the brightness amplifier position in the optical system.

As theoretical analysis shows, the joint effect of multiple reflections and aperture limitations leads to the following in the practically interesting cases. When the apertures operating in the resonator have being sufficient for transmitting the details of the initial images, the multipass resonator favors obtaining sharp images and allows one to separate partially overlapping details and to form sharp and contrast images.

Taking into account the properties of liquid-crystal modulators in such systems, one can perform nonlinear transformations, such as contrast increase, color tint variations, and then provide high quality of the image of a colored dynamical object. It is also favored by appropriate optical adjustment that makes it possible to obtain the same image size for each color.

Quite ordinary commercially available elements were used in the laboratory experimental setup. For example, the AKVILON telemonitor was used as controlled pulse generator, compatible with SONY videorecorder. MDS-LC structure or matrix cells were used as light modulating elements. Objectives with focal length not less then 50 cm were used for reading the TV image data; Cu, Au, and Sr-vapor laser active media were used as quantum amplifiers operating at the wavelengths of 510.6, 627.8, and 430.0 nm, respectively, with the average radiation power about 5 W. Usual screen was used, particularly, the reflecting screen with the size of 5×3 m, that had the property of amplifying due to change in the directional pattern. The contrast ratio of about 30 was reached with the number of reproduction of the gray scale gradations of 3–4.

The experiments showed that the main factor preventing creation of color TV projection systems, based on the brightness amplifying principle, is now the absence of powerful Sr-vapor lasers. So the attempts are undertaken now to find another alternative techniques for realizing the color projection systems.

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