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# Canadian Contribution to Hologrammetry

Research in hologrammetry since 1969, and future directions in research, are discussed

**I**N 1967, AN ARTICLE in the French scientific review *Sciences et Vie* came to my attention as to many readers. Having taken the first courses in photogrammetry, it became evident immediately upon reading the first few lines of this article that holography would one

research work: "I want to mention these experiments because they directly interest photogrammetry and I regret being unable to fix the tolerance between the positioning of the object and its image reconstructed by holography. This question has been asked of

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*ABSTRACT: A review is made of the research we have undertaken since 1969 in hologrammetry. Discussion on the directions we think hologrammetric research will take is emphasized and some mention is made of our current and intended investigations, i.e., automatic contour line generation with conventional stereomodels by means of laser techniques.*

*RESUME: Nous passons en revue les travaux que nous avons effectués depuis 1969 dans le domaine de l'hologrammétrie. Nous dégageons les orientations que l'hologrammétrie devrait, à notre avis, suivre à l'heure actuelle et nous disons un mot de nos recherches présentes, c'est-à-dire de la formation automatique des courbes de niveau dans des stéréomodèles conventionnels au moyen de techniques laser.*

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day be utilized by photogrammetrists because it was a new means of recording three-dimensional pictures.

In 1968, I became a student in Québec preparing a master's degree in photogrammetry. I decided as a thesis topic to investigate direct measurement in holograms, which had never been done. Mrs. Madeleine Marquet, from the Optics Institute of Paris, in July 1968 at the XI International Congress of Photogrammetry, said concerning the institute's

me. I shall reply by saying that the whole problem is a function of the precision that could be obtained during the reconstruction, when the hologram is repositioned where it was during the recording. We are now investigating this by interposition of a réseau in the beams to increase the precision; however, as yet we have not obtained valuable results."

With the financial support of the Canadian Ministry of Energy, Mines and Resources, we have worked on that problem for two years.

To solve the problem, we designed and built the first original holographic measuring device (Figure 1). At the end of 1969, our standard error of pointing was, for the three directions, 0.02 mm for X, 0.03 mm for Y, and 0.11 mm for depth. These results were presented at the first International Symposium of Holography held in Besançon, France, in July 1970<sup>1</sup>.

At the end of 1970, our research was satisfactorily completed and we were able to answer Mrs. M. Marquet. This was done by giving figures for the six different relative orientation elements of the hologram with respect to its divergent reference beam<sup>2 3</sup>.

In September 1970, at the Symposium of the I.S.P. Commission V on moving object photogrammetry, we pointed out<sup>4</sup> the great advantages of hologrammetry for high-speed motion problems.

In 1972, at the XIIth International Congress of Photogrammetry, I displayed a new hologrammetric measuring device for high-precision measurements<sup>5</sup>. With the attachment being mounted on a Wild A7 (Figure 2) I obtained better standard errors, i.e.: 0.008 mm for X, 0.013 mm for Y, and 0.070 mm for Z.

In October 1972, at the ACSM-ASP Convention at Columbus, I presented a paper entitled "Numeric Relative Orientation in Hologrammetry,"<sup>6</sup> in which I proposed a

mathematical method for repositioning holograms by means of error deformation measurements.

At the 1973 ASP-ACSM Convention in Washington, I participated in a group discussion dealing with close-range photogrammetry<sup>7</sup>. My principal contribution was to point out the need for a commercial version of an hologrammetric apparatus, not specially for photogrammetrists, but to help all hologram users interested in holographic measurement. People are not making holographic measurements because they simply do not know that such measurements are possible. I am still convinced that, even with rough measurements (0.1 to 0.2 mm accuracy), great improvement could be made in interferometric holography. This could be done by measuring not on the image object but on the interferometric fringes in order to determine their location, their form, and the exact space between two consecutive fringes.

As far as the near future is concerned, we are working on a project to automatically generate contour lines onto conventional stereomodels. We intend to use first, pairs of terrestrial photographs of a three-dimensional model and then, if successful, to apply the same methods using aerial stereomodels. We hope to be able to report favorably on the progress of our research at the time of the congress.

#### REFERENCES

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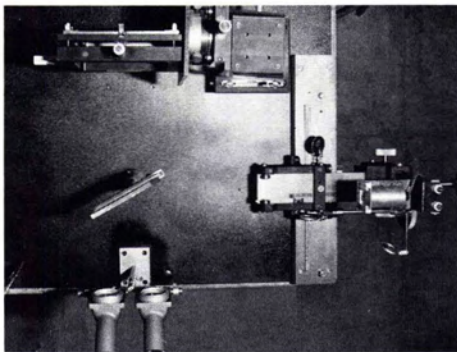


FIG. 1. First original hologrammetric apparatus.

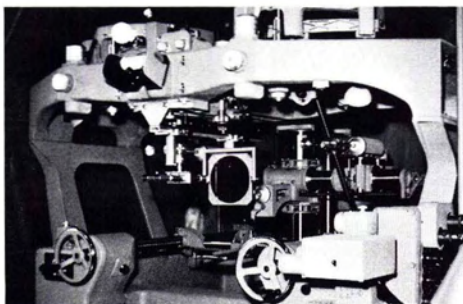


FIG. 2. Hologrammetric attachment for the Wild A7.