NATIONAL BUREAU OF STANDARDS REPORT

4012

PROPOSAL FOR THE USE OF THE KINORAMA

Progress Report

by

F. C. Breckenridge

to
Bureau of Aeronautics
Department of the Navy

U. S. DEPARTMENT OF COMMERCE
NATIONAL BUREAU OF STANDARDS

U. S. DEPARTMENT OF COMMERCE
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NATIONAL BUREAU OF STANDARDS
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THE NATIONAL BUREAU OF STANDARDS

The scope of activities of the National Bureau of Standards is suggested in the following listing of the divisions and sections engaged in technical work. In general, each section is engaged in specialized research, development, and engineering in the field indicated by its title. A brief description of the activities, and of the resultant reports and publications, appears on the inside of the back cover of this report.

Electricity and Electronics. Resistance and Reactance. Electron Tubes. Electrical Instruments. Magnetic Measurements. Process Technology. Engineering Electronics. Electronic Instrumentation. Electrochemistry.

Optics and Metrology. Photometry and Colorimetry. Optical Instruments. Photographic Technology. Length. Engineering Metrology.

Heat and Power. Temperature Measurements. Thermodynamics. Cryogenic Physics. Engines and Lubrication. Engine Fuels.

Atomic and Radiation Physics. Spectroscopy. Radiometry. Mass Spectrometry. Solid State Physics. Electron Physics. Atomic Physics. Nuclear Physics. Radioactivity. X-rays. Betatron. Nucleonic Instrumentation. Radiological Equipment. AEC Radiation Instruments.

Chemistry. Organic Coatings. Surface Chemistry. Organic Chemistry. Analytical Chemistry. Inorganic Chemistry. Electrodeposition. Gas Chemistry. Physical Chemistry. Thermochemistry. Spectrochemistry. Pure Substances.

Mechanics. Sound. Mechanical Instruments. Fluid Mechanics. Engineering Mechanics. Mass and Scale. Capacity, Density, and Fluid Meters. Combustion Controls.

Organic and Fibrous Materials. Rubber. Textiles. Paper. Leather. Testing and Specifications. Polymer Structure. Organic Plastics. Dental Research.

Metallurgy. Thermal Metallurgy. Chemical Metallurgy. Mechanical Metallurgy. Corrosion.

Mineral Products. Porcelain and Pottery. Glass. Refractories. Enameled Metals. Concreting Materials. Constitution and Microstructure.

Building Technology. Structural Engineering. Fire Protection. Heating and Air Conditioning. Floor, Roof, and Wall Coverings. Codes and Specifications.

Applied Mathematics. Numerical Analysis. Computation. Statistical Engineering. Mathematical Physics.

Data Processing Systems. Components and Techniques. Digital Circuitry. Digital Systems. Analogue Systems.

Cryogenic Engineering. Cryogenic Equipment. Cryogenic Processes. Properties of Materials. Gas Liquefaction.

Radio Propagation Physics. Upper Atmosphere Research. Ionospheric Research. Regular Propagation Services.

Radio Propagation Engineering. Frequency Utilization Research. Tropospheric Propagation Research.

Radio Standards. High Frequency Standards. Microwave Standards.

- Office of Basic Instrumentation
- Office of Weights and Measures

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for
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Navy Department

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NBS

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1. PURPOSE

The kinorama is a device for evaluating the relative merits of approach and runway lighting configurations. It is now in operating condition. The purpose of this report is to outline methods for using it to improve the safety of all-weather landings.

2. OPERATION OF KINORAMA

In the kinorama, approach-light and runway-light configurations are represented by fluorescent miniatures which may be three dimensional when desired. These miniatures move in such a way as to simulate the apparent relative motions of lights as seen by a pilot flying an airplane over them. By connecting the mechanism of the kinorama to the controls of a Link trainer the movements of the lights is varied in accordance with pilot's use of those controls. Forward, vertical, and transverse motions and yawing, banking, and pitching are all simulated, while an electric recorder makes a record of the horizontal and vertical traces of the path followed by the pilot.

3. FLEXIBILITY OF KINORAMA

The kinorama has been designed for maximum flexibility in use. This flexibility includes:

1. Adjustments to simulate different types of aircraft.

These adjustments are made under the guidance of a pilot accustomed to fly the type of aircraft to be simulated except that changes in cockpit cutoff are based on measurements.

2. Adjustments for different types of problems including:

2.1. Variability of configurations.

2.2. Variability of atmospheric condition simulated.

These include visibility and cross wind.

2.3. Variability of initial position and heading.

This provides for the residual error of electronic guidance.

3. The kinorama has been built to meet the need for:

3.1. A device for demonstrating configurations to responsible officials.

3.2. An instrument for basic research.

3.3. Equipment for applied research with untrained operators.

3.4. Evaluations with experienced pilots.

3.5. A synthetic trainer for landing in fog.

This flexibility for different uses has been attained by circuits which permit the controls to be shared in any combination between the operator ("pilot") and the controller, with or without interactions between the controls.

4. MOBILITY

It is evident that the different applications outlined in (3) call for the services of different types of personnel. Basic research is generally carried on at universities. Applied research may be carried on at a university or at a government laboratory having a qualified psychological division. Evaluations should be done, in their final stages at least, at the air stations where the most outstanding pilots are available. Experience

with an evaluation project using an earlier model of the kinorama showed that it is impracticable to get sufficient pilots to come to a laboratory a few miles from their offices. Demonstrations are practicable only if the kinorama can be located within a few miles of the officials concerned. Generally this means in the metropolitan Washington area.

The kinorama can be made available for these different applications if it is made mobile by installing it in a trailer such as is used for radar.

5. PROPOSED PROGRAM

The following program is proposed to be carried out largely with funds that have already been made available:

1. Demonstrations

In view of the standardization of approach-light configurations now being carried out by representatives of the Air Force and Navy, it is recommended that the kinorama be made available at once for the demonstration of configurations which are under consideration and that the pilots and officials responsible for this standardization be invited to make use of this service. No additional funds are required.

2. Exploratory tests

Exploratory tests have been initiated to determine how many hours practice are required to enable naive observers to operate the kinorama and what degree of precision may be expected from such observers after a reasonable period of training. This work is being carried on in consultation with Prof. Hackman of the University of Maryland, his services having been made available by the Office of Naval Research. These tests should be continued as time permits. No additional funds are required.

3. Trainer Development

The Special Devices Division should be requested to inspect the kinorama at its earliest opportunity to determine if plans should be made for the development during the coming fiscal year of a training simulator. If such a development is decided upon, the major part of the work should be carried on by a manufacturer of such equipment so that the resulting design will be suitable for immediate production. No funds are required for demonstrating the device to the Special Devices Division and any development work undertaken would presumably be at the expense of some division other than the Airbourne Equipment Division. No additional funds requested.

4. Transfer to Trailer

It is recommended that the installation of the kinorama in a trailer be authorized subject to its being found practicable to obtain a suitable trailer. It is probable that an obsolete radar trailer would serve the purpose. Apart from the cost of placing the trailer at the National Bureau of Standards, the cost would be less than that of moving the kinorama to any point outside of the Washington area and about the same as that of moving it to some nearby fixed location. About three months should be allowed for installing kinorama in a trailer. If the demonstrations recommended in 5.1 are completed in time, the work can be started in the present fiscal year on funds already available. The completion of the work will require between $2500 and $7500 in f.y. 1956 according to how much of the work can be done before June 1. Procurements and shop work are estimated at $1000 to be obligated in f.y. 1955.

5. Research and Evaluations

It is recommended that the Office of Naval Research be invited to make use of the kinorama for research and evaluation purposes, the control of the

device remaining with the Airborne Equipment Division and the National Bureau of Standards being designated to represent that Division as consultants in connection with such projects as may be undertaken. There would be no cost for the f.y. 1955. The cost for f.y. 1956 is tentatively estimated as $3000.

6. Conclusion

In concluding this proposal it seems appropriate to summarize the advantages of using the kinorama for the evaluation of approach-light systems. An adequate program for such evaluations should provide for use of a large number of pilots. Between 50 and 100 pilots are desirable. Such pilots should represent the several types of flying that would use the approach lights in service. With the kinorama each will be required to devote only one or two days' time to the work and this can be done in several short intervals arranged to interfere as little as practicable with his other duties. By comparison, flight testing in fog requires so much special training with the facilities under test, and so much time lost awaiting the occurrence of unpredictable fog, that it is quite impractical to utilize such a large representative group of pilots in flight testing. In addition pilots assigned to such a flight test would have to devote weeks and perhaps months to make the usual tests.

The one or two days' time estimated for each pilot assigned to a kinorama evaluation covers the time required for familiarization and the making of at least 90 simulated "approaches". Thus the program provides for between 4500 and 9000 "approaches", not counting those required for the initial orientation. Experience at the Landing Aids Experiment Station

at Arcata, California, indicated that between 600 and 650 approaches in fog could be made per year at that station which was maintained for that purpose alone in the most favorable location in the U. S. It would have taken Arcata 12 years to have made as extensive a study as the one described in this program. It would, of course, take much longer at an air station having less foggy days especially if the station is engaged in other projects that are considered important enough so that some fogs go by without it being possible to utilize them in the approach-light testing program. With the kinorama it should be possible to complete a good program in 6 months.

With the kinorama an evaluation project can be designed to cancel out extraneous factors and base the comparisons on highly comparable conditions. Even if a 12 year study were carried out at an airfield, it would not be possible to rival the precision with which these two essential elements of sound testing procedure can be attained with the kinorama.

It is not necessary to emphasize the advantages of the kinorama from the standpoint of eliminating hazards to life and equipment.

Summary of funds requested[1]

	Fiscal Years 1955	1956
1. Demonstration of new standard	None	None
2. Exploratory tests	None	None
3. Trainer development	None	None
4. Transfer to trailer	$1000	$7500
5. Research and evaluations	None	3000
	$1000	$10500

[1]The personnel costs of program in f.y. 1955 will be charged to funds already provided by Airborne Equipment Division. No estimate of costs for other divisions has been made pending indication that such estimates are desired.

Description of Figures

Figures 2 to 6 were taken during construction of the kinorama. A considerable number of parts, including the three missing instruments, have been added since these photographs were taken.

Figure 1 - Schematic drawing showing the principle of the kinorama's operation.

Figure 2 - A view of the kinorama as a whole from the pilot's end.

Figure 3 - A general view from the controller's end of the kinorama. The table assembly is in the upper portion of the foreground.

Figure 4 - View showing amplifiers, relay chassis, and power unit.

Figure 5 - Close view of part of telescope assembly and rear of telescope assembly chassis.

Figure 6 - View of kinorama control table.

THE NATIONAL BUREAU OF STANDARDS

Functions and Activities

The functions of the National Bureau of Standards are set forth in the Act of Congress, March 3, 1901, as amended by Congress in Public Law 619, 1950. These include the development and maintenance of the national standards of measurement and the provision of means and methods for making measurements consistent with these standards; the determination of physical constants and properties of materials; the development of methods and instruments for testing materials, devices, and structures; advisory services to Government Agencies on scientific and technical problems; invention and development of devices to serve special needs of the Government; and the development of standard practices, codes, and specifications. The work includes basic and applied research, development, engineering, instrumentation, testing, evaluation, calibration services, and various consultation and information services. A major portion of the Bureau's work is performed for other Government Agencies, particularly the Department of Defense and the Atomic Energy Commission. The scope of activities is suggested by the listing of divisions and sections on the inside of the front cover.

Reports and Publications

The results of the Bureau's work take the form of either actual equipment and devices or published papers and reports. Reports are issued to the sponsoring agency of a particular project or program. Published papers appear either in the Bureau's own series of publications or in the journals of professional and scientific societies. The Bureau itself publishes three monthly periodicals, available from the Government Printing Office: The Journal of Research, which presents complete papers reporting technical investigations; the Technical News Bulletin, which presents summary and preliminary reports on work in progress; and Basic Radio Propagation Predictions, which provides data for determining the best frequencies to use for radio communications throughout the world. There are also five series of nonperiodical publications: The Applied Mathematics Series, Circulars, Handbooks, Building Materials and Structures Reports, and Miscellaneous Publications.

Information on the Bureau's publications can be found in NBS Circular 460, Publications of the National Bureau of Standards ($1.25) and its Supplement ($0.75), available from the Superintendent of Documents, Government Printing Office. Inquiries regarding the Bureau's reports and publications should be addressed to the Office of Scientific Publications, National Bureau of Standards, Washington 25, D. C.


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