MEMORANDUM OF AGREEMENT
BETWEEN
SUPERINTEDENT REMOTE SENSING DIVISION, NAVAL RESEARCH LABORATORY
AND
UNIVERSITY OF PUERTO RICO, MAYAGÜEZ CAMPUS

Subj: OPTICAL WAVEFRONT SENSING AND LASER COMMUNICATION

1. **PURPOSE.**

This agreement between the Superintendent of the Remote Sensing Division, Naval Research Laboratory (NRL), 4555 Overlook Ave. SW, Washington DC 20375, and the Chancellor of the Mayagüez Campus of the University of Puerto Rico, to support mutual research in the broad areas of Optical Signal Propagation and Laser Communication technologies.

2. **BACKGROUND.**

a. The Remote Sensing Division at the Naval Research Laboratory conducts a program of basic research, science and applications, to develop new concepts for sensors and imaging systems for objects and targets on Earth, in the near-Earth environment, and in deep space. The research includes theory, laboratory, and field experiments leading to ground-based, airborne, or space systems for use in remote sensing, astrometry, astrophysics, surveillance, non-acoustic ASW, meteorological/oceanographic support systems for the operational Navy, and environmental/global climate change assessment. Special emphasis is given to developing space-based platforms and exploiting existing space systems. The Remote Sensing Division operates the Navy Prototype Optical Interferometer (NPOI), a major facility that is actually two collocated instruments for making high-angular-resolution optical measurements of stars. Light from widely separated individual siderostats is combined simultaneously to synthesize the angular resolution of a telescope tens to hundreds of meter in diameter. Four siderostats are placed in an array with extremely accurate metrology to enable very-high-precision measurements of stellar positions. The U.S. Naval Observatory uses these measurements to refine celestial reference frame and to determine Earth rotation parameters to satisfy Navy requirements for precise time and navigation data. Division personnel have started a study, with experimental verification, of the interaction of Adaptive Optics with optical interferometry to increase the NPOI's sensitivity. When completed, the NPOI will be the most advanced, high-resolution imaging optical interferometer in the world. Division scientists are also involved in advanced demonstrations of laser communication using a Modulating Retro-Reflector (MRR) technology. The Division is also the government authority overseeing the Magdalena Ridge Observatory (MRO) program, which is developing a new optical interferometer facility in New Mexico.

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b. The Mayagüez Campus of the University of Puerto Rico (UPRM) is a public Land Grant institution of higher learning, of approximately 12,000 Hispanic students located in the western municipality of Mayagüez, Puerto Rico. On average the campus awards 1,300 bachelor degrees, 125 masters and 3 doctoral degrees per year providing over twenty five percent of the minority engineering and science workforce in the United States. The Department of Physics of UPRM has an active interest in techniques of optical wavefront sensing, interferometry and adaptive optics. The research includes simulation, instrument development and field experiments, some of which are carried out at the National Astronomy and Ionospheric Center's Arecibo Observatory. UPRM is also part of the consortium of universities involved in the Magdalena Ridge Observatory program.

3. **SCOPE.**

a. This MOA commits the parties to provide facility access time and assistance from their personnel; it does not commit the parties to exchange funds.

b. In order that both organizations may improve their research and development understanding in the fields of Optical Signal Propagation and Laser Communications, the NRL Remote Sensing Division and the University of Puerto Rico, Mayagüez Campus enter this agreement. In specific:

c. The Remote Sensing Division shall support the University of Puerto Rico, Mayagüez Campus by:

1) Providing access for UPRM personnel to the NPOI facility and assistance in its use — access to observing time on the NPOI shall be contingent on the standard scheduling procedures applying to NRL RSD personnel;
2) Assisting UPRM personnel in the use of day-time adaptive optics and other high angular resolution techniques;
3) Assisting UPRM personnel in using laser communications technologies, including joint field experiments.

d. The University of Puerto Rico, Mayagüez Campus shall support the Remote Sensing Division by:

1) Providing access to instrumentation and assistance in their use for the specific purpose of horizontal path length laser propagation over the tropical marine environment;
2) Collaborating and assisting in the development of adaptive optics for advanced applications, including and not exclusive to the marine environment;
3) Providing workspace for a Remote Sensing Division representative.

4. **AUTHORITY.**

This Agreement does not supersede any regulations or directives of higher authority. If either party learns that the agreement violates such directives, they shall immediately notify the other party and shall jointly determine whether to terminate the agreement or conform it to the directives.

5. **EFFECTIVE DATE AND DURATION.**

This agreement becomes effective on the last date signed by the authorized representatives identified below. The agreement shall remain in effect indefinitely but may be modified by joint, written agreement or terminated upon 30 days written notice from either party.

JEFF McCANN, LTC
Branch chief
AFRL DET 15

JORGE IVÁN VÉLEZ AROCHO, Ph.D.
Chancellor
University of Puerto Rico, Mayagüez Campus