DEPARTMENT OF THE NAVY
NAVAL RESEARCH LABORATORY
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IN REPLY REFER TO:

DATE: June 22, 2004

FROM: Dr. J. Edward Swan II
Naval Research Laboratory Code 5580
4555 Overlook Ave SW
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RE: Mr. Jesus Arango's research contributions to the Naval Research Laboratory

To Whom It May Concern:

In this letter I describe Mr. Jesus Arango's significant achievements and research contributions to the United States Navy. As I discuss below, I have collaborated with Mr. Arango on two projects at the Naval Research Laboratory; our collaborations were conducted when Mr. Arango worked at our laboratory on several visiting research contracts from 2000 through 2002. During the course of this work Mr. Arango greatly distinguished himself in the areas of distributed computing, terrain rendering, virtual reality, and augmented reality. While here, he has directly worked with me. I am extremely impressed with Mr. Arango, and recommend him without hesitation.

I am a research scientist with the Naval Research Laboratory in Washington, DC, USA. My laboratory conducts basic research and development in areas of interest to the United States Navy. I work for the Virtual Reality Lab; my work here involves the development of new algorithms and techniques in the areas of augmented reality, virtual reality, computer graphics, and human-computer interaction. Our lab currently employs 7 full-time research staff members. We are a very academically oriented; from 2002 through 2004 our lab has published 14 papers in journals, as book chapters, and in conference proceedings; I have been a co-author on 9 of these papers. Our work has appeared in major, international venues such as *Presence: Teleoperators and Virtual Environments*, the *International Symposium on Mixed and Augmented Reality*, *Institute of Electronic and Electrical Engineering (IEEE) Virtual Reality*, *IEEE Visualization*, and *IEEE Computer Graphics and Applications*.

Mr. Arango collaborated on a project to develop new graphics algorithms for rendering large terrain datasets. Before Mr. Arango's arrival, our system employed a novel real-time terrain rendering algorithm, but the latency variance in rendered frames made the system unusable. We wanted to try a distributed computation approach to reduce the latency variance, and we hired Mr. Arango for his expertise in this area. Mr. Arango split the original system, which runs in a single thread, into a series of cooperating threads which run on two different machines. His solution reduced the variance by a factor of 18, from 644 ms to 35 ms. As 35 ms of latency is imperceptible, the system is now usable in a real-time context. Mr. Arango and I later collaborated on a paper[1] that describes this result; this paper was published in *Visualization and Data Analysis 2002*, an international conference sponsored by the *International Society for Optical Engineering*.

[1] J. Edward Swan II, Jesus Arango, Bala Nakshatrala, "*Interactive, Distributed, Hardware-Accelerated LOD-Sprite Terrain Rendering with Stable Frame Rates*", Visualization and Data Analysis 2002, R. Erbacher, P. Chen, M. Gröhn, J. Roberts, C. Wittenbrink, Editors, Proceedings of SPIE Volume 4665, pages 177–188, 2002.

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Mr. Arango also collaborated on a project to add a terrain-based navigational system to our Battlefield Augmented Reality System (BARS). BARS has been our laboratory's main project for the past 5 years. Mr. Arango's navigational system allows users of the virtual reality portion of the BARS system to manipulate their view of a large terrain dataset using a metaphor of flying in an airplane. Before Mr. Arango's work, users did not have a way of navigating through terrain datasets using BARS. Because BARS is designed to be used over a wide geographical area, Mr. Arango's contribution is a critical addition to the command and control component of BARS. In addition, Mr. Arango independently conceived and implemented a novel calibration technique for BARS, which greatly improves and simplifies our previous technique. This effort was not an original component of the project, but is an example of the way Mr. Arango independently pursues opportunities that arise during the course of his efforts. We are currently preparing a publication that covers this portion of Mr. Arango's work.

I am very impressed with Mr. Arango's performance, because (1) he came up-to-speed very quickly with two complex, existing systems; (2) he obtained research results in an area (computer graphics) that is not his specialty; (3) Mr. Arango quickly formulated and clearly communicated detailed research approaches for both projects; and (4) in both cases Mr. Arango quickly accomplished his main goals, and had time to pursue several additional ideas.

To summarize, it is my opinion that Mr. Arango's research contributions at our laboratory have significantly contributed to a research program of sustained importance and relevance to the United States Navy. If you desire further information about my experiences with Mr. Arango, please do not hesitate to contact me, either by phone, email, or surface mail.

Sincerely,

J. Edward Swan II

Dr. J. Edward Swan II

Computer Scientist,
Virtual Reality Lab,
Information Technology Division,
Naval Research Laboratory.