May 9, 2008

Dear Prof. Dr. Wuttig,

I am responding to the announcement for a position as Junior Professor in the Department of Computer Science at RWTH Aachen University. In this letter I highlight how my long term plan, skills, and accomplishments make me a candidate for the offered position.

My area of expertise is broad and spans the fields of scientific computing, high-performance computing, with a particular focus on automation. The nature of my research is interdisciplinary; it naturally leads to collaborations both within and outside the boundaries of computer science.

My long term research objective is twofold. On one hand, I aim at bridging the gap that traditionally separates algorithm development from both architectures and scientific applications. Superior algorithms, in terms of performance and/or accuracy, can only be achieved by integrating knowledge from applications, algorithms, and architectures. I am looking forward to the opportunity of creating a team of students and scientists that combines skills from these three areas. The second research objective concerns automation. My interest is not limited to problem solving, it extends to the uncovering of the mechanisms underlying a solution process. It is these mechanisms that make computer automation possible. During my career as research associate and graduate student, I tackled both the aforementioned goals; here I report on the most salient results.

As a research associate in the Computer Science Department at Duke University, my research focuses on the coupling between scientific computing and new architectures. In collaboration with Prof. Xiaobai Sun, I am studying and developing digital signal processing algorithms for medical and audio&video streaming applications. Thanks to the joint understanding of the target architecture and of the algorithmic space, we built an algorithm for (streaming) Fast Fourier Transforms on the Cell Broadband processor. Among the existing codes, ours attains the best performance. Thanks to the expertize I gained on the Cell processor, I have been invited to join the editorial board of the Journal of Scientific Programming for a special issue on High-Performance Computing on the Cell.

In late 2006, NSF funded a project on the interface between algorithms and engineering applications. Specifically, I am involved in the design of a sparse direct solver for *hp*-adaptive Finite Element Methods; the goal to make it possible for the solver to access and exploit information about the problem domain that is naturally available in the application. I presented preliminary results the past summer in Zurich at the Congress on Industrial Mathematics (ICIAM); this project is conducted in collaboration with a team of applied mathematicians from the Texas Advanced Computing Center (TACC) and the Institute for Computational Engineering and Sciences (ICES). Numerous scientific and engineering applications would benefit greatly from the success of this project.

During my graduate studies I achieved remarkable results in automation. My dissertation, "Mechanical Derivation and Implementation of Correct Linear Algebra Algorithms and their Stability Analysis", supervised by Prof. Robert van de Geijn at the University of Texas at Austin, is possibly the first instance in which classic computer science techniques have been applied to numerical and high-performance computations. The thesis was selected as the Computer Sciences department candidate for the 2006 ACM Doctoral Dissertation Award, and it has been recently selected as a finalist for the Householder Award, to be assigned in June. The Householder Award is a prestigious recognition, awarded every third year, for the best doctoral dissertation in numerical linear algebra.

In addition to automation, the dissertation draws from, and contributes to, many areas of computer science: high-performance computing, formal methods, numerical analysis and symbolic systems. At the early stages of the research, Prof. van de Geijn and I prepared a proposal centered around our initial investigations; the proposal was awarded and I received financial support from the consequent NSF grant. My dissertation introduces a methodology and a mechanical system that generate algorithms (and code) with limited human intervention. I used this system, as part of a collaboration with aerospace engineers, to generate a family of algorithms related to the accurate estimation of the gravitational Earth field. The same techniques are relevant for studying noise in tomography, in medical nuclear imaging. The results from this collaboration and from my dissertation have been presented at conferences and generated multiple publications.

When I joined the Ph.D. program at the University of Texas, I became involved in the development of a symmetric parallel eigensolver. The collaboration with Prof. Inderjit Dhillon and Prof. Robert van de Geijn originated the first parallel algorithm that uses the SIAG/LA award winning method of Multiple Relatively Robust Representations. This project led to a publication in the SIAM Journal on Scientific Computing (SISC), the top journal in the field. In addition, in 2005, I was invited to present our algorithm at the Householder Symposium, the (invitation-only) most reputable conference in linear algebra. The project also led to software that is used by scientists, as a computational engine, and by researchers in linear algebra, as a performance reference. To this date, my tridiagonal eigensolver is the fastest available.

I believe that it is duty of a scientist not only to solve problems, but also to disseminate results and to identify new research directions. In this respect, in the past five years I was given the freedom to pursue my own research interests. I wrote articles and gave many talks around Europe and the US. I also assumed the role of educator, advising junior graduate students and teaching undergraduates. Teaching, either in a classroom setting or in a research meeting, is a second form of dissemination, which I enjoy thoroughly. As I firmly believe that the visualization of concepts is an effective teaching tool, in my lectures and presentations I often make use of Mathematica as an instrument to demonstrate and prototype ideas. In my web page, `http://www.cs.utexas.edu/users/pauldj`,

I include a number of illustrations and demos of lectures and research projects.

Beyond the scientific accomplishments, I would also like to stress the breadth of my scientific background and my position and the experience I gained as a naval officer. During my Masters degree in computer science at the University of Pisa, in Italy, I received a broad classical education in both mathematics and computer science. My background was then strengthened through three international summer schools and at the University of Texas, through eleven graduate courses. In many circumstances throughout my career this breath in education has played a crucial role. Here I only mention two of them. First and foremost, it allowed me to integrate concepts from areas as diverse as numerical analysis and formal methods, generating the core results of my dissertation; these two areas had never been linked before. In addition, it gave me the capability of establishing different languages for interacting with different audiences. I was able to both effectively teach to computer science as well as non-computer science students, and to conduct productive collaborations with computer scientists, applied mathematicians, and engineers.

Upon completion of my Masters, it was mandatory for me to serve in the military. I qualified to the officers training camp at the Italian Naval Academy which I completed ranking first among 170 cadets; I so became officer in the Navy. With the rank of ensign, the captain appointed me as the Academy chief trainer, designating me as the sole person responsible for the training of a new class of cadets and for the management of other 12 trainers. Evidence of my success in this role as instructor and leader is provided by the fact that at the end of the year, among more than 500 officers, I received the "Officer of the Year" award and fellowship. This experience gave me a strong background in management, teaching, and interpersonal relations skills.

In summary, I believe I can contribute to the Department of Computer Science at RWTH Aachen University both as an effective educator and as a successful researcher. I am looking forward to having the opportunity to further discuss my skills and objectives. I thank you in advance for your time.

Best Regards,

Paolo Bientinesi.

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