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Prof. Dr. M. Wuttig
Dean, Faculty for Mathematics
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RWTH Aachen University
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Letter of recommendation for Dr. Paolo Bientinesi

Dear Dr. Wutting :

I am writing this reference letter in support of Dr. Paolo Bientinesi being considered for a Junior Professor on your faculty. On a postdoctoral position at the Department of Computer Science, Duke University, Dr. Bientinesi has worked closely with me from Sept. 2006 to April. 2008. I consider myself know him fairly well and provide you with a few particular points of view.

Paolo has chosen his professional career as an independent researcher in academia. In fact, he got quite a few handsome offers from prestigious research divisions at industry laboratories, such as that at Microsoft and at IBM, which are envied by many other postdocs and new PhDs. Paolo appreciates and strives to succeed in academic research in computational sciences and natural sciences, which affect our knowledge and technologies in many aspects of our lives and societies at present and in the future.

Paolo values highly the faculty, students and the academic environment at RWTH Aachen University, above other important factors. I believe, he is a great asset to your university and his arrival increases the visibility band of the university. Besides many talk invitations and job offers, Paolo is a finalist for the Householder Prize 2008, which is awarded once for every three years. In other words, he is seen as in the top 5 among all the new PhDs worldwide in the last three years in the area of Matrix Theory and Computation.

We can estimate Paolo's potential and trajectory in professional and intellectual development by what he has achieved. Paolo's dissertation is on automatic code generation for matrix computations, especially, for solving extremely large symmetric and positive linear systems via Cholesky factorization. Among the precursors to this kind of automation work, in addition to the PLA-pack by his thesis adviser, are the Automatic Differentiation led by C. Bischof in early 1990s, FFTW by A. Johnson and M. Frigo, SPIRAL led by M. Jose, and ATLAS led by J. Dongara, in late 1990s. Paolo's automation system translates an algorithm description at a high-level in the form of matrix partition to that at the low level of programming in a common language such as C. The translation is one to many. His system selects the best algorithm variant automatically with respect to certain performance criteria. This task was seen very ambitious and challenging. Paolo succeeded, all by himself. I met him at the Householder Symposium in 2005, before he received his PhD. Professor G. W. Stewart, a pioneer and authoritative figure in matrix computation, told me in person that he saw a great promise in Paolo.

During his time at Duke University, Paolo has expanded his research experience. He collaborated

with me on fast and accurate evaluation of Prolate Spherical Wave functions. This has important applications in high-resolution signal processing. Both the algorithm and the code we developed are unique in efficiency and accuracy. The algorithm is perhaps the first with error feedback and control during evaluation.

Paolo has also collaborated with me and Dr. Nikos Pitsianis on the mapping of multi-dimensional Fast Fourier Transform (FFT) to the Sony-Toshiba-IBM Cell broadband engine (Cell). The FFT is ubiquitous in signal and image processing applications. Our particular goals include the use of the FFT with accurate sample translation for synthetic aperture radar(SAR) imaging and similar kinds of two-dimensional or three-dimensional image formation. The FFT has also a representative role in high performance computing in the narrow sense that it has a very low ratio in data reuse, in comparison to dense matrix computations. On the other hand, the multicore architecture and programming represent a paradigm shift in algorithm-to-architecture mapping. The Cell, initially for game processing, is increasingly used for high-performance computing at low power consumption. A successful mapping is to exploit both algorithmic and architectural architectures. This joint exploitation differs significantly from Paolo's thesis work, which is within algorithmic variation. It deals with fast algorithms, sparse structures and multi-dimensional data, all different from his dissertation work. Not limiting ourselves to heuristics or experiment driven approaches, we developed an elegant theory on the architecture-algorithm relationship in terms of match or mismatch between algorithmic dimension and architectural dimension. The theory explains why certain 'tricks' of 'black art' in wide use have worked, and more importantly, it brings to light the essential rules for reducing latency and achieving high performance without extensive and exhaustive search. This line of work led to the recognition that Paolo is invited to serve on the editorial board for a special issue of the journal *Scientific Programming* with topics on Computing with the Cell.

Meanwhile Paolo has also continued his close collaboration (weekly or daily sometimes) with his colleagues at Austin on other kinds of application-rich computing problems. I am quite confident that his colleagues there will provide you with more complementary information and compliments.

Paolo's extra-ordinary accomplishments in the very recent few years may not fully measure his increased potential by his continuous learning, reflection, engagement in professional criticism and mutual stimulation, grown tastes and choices in research topics, and hard working. Moreover, he voices and listens to different opinions. He has become a rich researcher, with cross-disciplinary skills in architectures, algorithms and numerical analysis. It is not easy to find such a research collaborator. At personal level, Paolo is very polite and considerate of the others. Every time I see him, I can not miss noticing that he is neatly dressed, unlike many others surrounding him (including myself). This is consistent with his professional working fashion.

Finally, I would like to add that the present priority of our department is on enhancing our research areas in artificial intelligence and experimental systems. If Scientific Computing were on the priority, I would recommend Paolo as our first choice.

Sincerely,

Xiaobai Sun
(Associate Professor)