Statements on Research and Teaching

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1 Introduction

My PhD candidate opportunity appeared when I was serving my military service at the school of Informatics of the Military, September 2004-September 2005. I had previously applied for several research positions at the National Center of Scientific Research Demokritos. I received a phone call from Prof. Stavros Perantonis, head of Research of the Institute of Informatics at Demokritos, inviting me to audition for a PhD position on a project sponsored by the European Union. I successfully auditioned in the committee and I got the position to work on the sponsored project “Part based 3D representation for the retrieval of 3D graphical models” which became my PhD topic and title. After successfully completing my PhD having published 3 papers to international journals and 1 conference paper which up to now have been referenced 128 times, I began working for two years on teaching University students courses privately making them successfully pass them, while previously they were continuously failing. Also I have helped students passing the University entrance exams with a particular case of a student who had no knowledge of programming passing the entrance exams of the Technical School of Athens in Informatics. In 2011 after communication with Prof. Ariel Shamir at the Efi Arazi school of Computer Science at the Interdisciplinary Center in Israel, I started my Post-Doc in cooperation with Prof. Daniel Cohen-Or at the department of Informatics of Tel Aviv University. The topic of my Research there was sketch interpretation and I cooperated closely with a Master student who was developing a graphical user interface for sketch interpretation in C#. I became also involved in its development enhancing the software. When the project was completed we published it in the prestigious Eurographics 2013 conference and it was nominated as one of the 6 best papers in the Conference. My post-doc finished in June 2012 and then I came in contact with Prof. Dana Petcu at the department of Informatics and Mathematics of West University of Timisoara, Romania. After a successful interview with her and Prof. Daniela Zaharie I was accepted as a researcher at the European Union funded HOST project and I am currently working on it until the end of December 2014. In this project I became a vital member of the group and collaborated successfully with its partners creating papers for international journals and conferences and created software prototypes in High Performance Computing. I also had many successful teaching and student supervision activities.

2 Research Statement

My career in Computer Science started when I enrolled in the Masters program of the department of Informatics of University of Athens. My first successful research attempt was with then PhD candidate Kai Hormann and now a Professor at the Informatics Institute of USI. In this first attempt I studied Prof. Hormann’s paper [1] in determining the intersection of two arbitrary polygons and I pinpointed the task of
determining if a point is inside a polygon, widely known as the point-in-polygon problem. My ideas on this problem led with the collaboration of Prof. Hormann to a joint paper [2] which is constantly referenced until now (73 references in Google scholar). During my studies on the Master program I was able to take many courses which were very useful in my later development, like parallel programming, computer graphics, image processing, signal processing. My current position in High Performance Computing was due to the dedication I showed in the parallel programming courses in the Masters degree and also my personal enrolment in it as a hobby (GPGPU programming with CUDA from 2009 onwards). Developing software and theory for HPC is a multidisciplinary process in the sense that it involves and requires knowledge from many other fields and apply this knowledge to develop theory and software tailored for HPC.

2.1 Research Highlights

I have published so far 14 papers in conferences and journals (mostly) which are constantly getting referenced. In my stay at the HOST project I have collaborated with colleagues from Spain, China and Portugal and have succeeded in having one major journal paper accepted, one Conference paper, submitted one Journal paper and preparing one more journal paper for submission. My Research focuses on the following topics spanning from my PhD till now.

2.1.1 Surface Segmentation

Surface segmentation is the process that divides a 3D object into its constituent parts. The 3D object is represented as a polygon approximation (usually triangles) called often 3D mesh and segmentation algorithms work on the triangles of the mesh dividing it parts. In my PhD thesis I was involved in segmenting a 3D

Figure 2.1: The steps of the segmentation algorithm.
object into its meaningful parts, meaningful in the sense of how human vision partition a 3D object. For instance a 3D object representing a human will be segmented in its head, hands, feet and main body, see [3] for a detailed and very popular (more than 90 citations) state of the art in surface segmentation algorithms.

In Figure 2.1 the surface segmentation is described. First (2 in Figure 2.1) the salient points of the mesh are extracted which are the points at the extremities of the mesh, then (3 in Figure 2.1) these salient points are grouped each one group representing a part of the object. Afterwards (4 in Figure 2.1) the main body of the mesh is approximated (yellow points in figure) using the salient points, then (5 in Figure 2.1) the boundary which separate the part from the main body is extracted (red curve in Figure). Last (6 in Figure 2.1) this boundary is refined by a minimum cut algorithm. Steps 5) and 6) are repeated for all groups of salient points. The interested reader can look at [4, 5] for a detailed description of the algorithm.

2.1.2 3D object retrieval

![Figure 2.2: 3D object retrieval process.](image)

3D object retrieval is the process where a 3D object is given as a query to a database containing 3D objects and the result are objects similar to the query object. Figure 2.2 shows the whole process. In my approach first the query object is segmented into its meaningful parts, using the segmentation methodology presented in Section 2.1.1. Then the different parts create an Attributed Relational Graph (ARG). The objects in the database are represented also as ARGs. The query object is compared to the objects in the database using graph matching under the Earth Movers Distance (EMD). The most similar objects to the query object should have lower EMD. For the interested reader the whole 3D retrieval process is described in detail in [4, 6, 7].

2.1.3 Sketch Interpretation

Sketch interpretation is the process in which a 3D model is acquired from a 2D sketch of a user, see Figure 2.3. In this figure a graphical user interface is illustrated showing the process of transition from a 2D sketch to a 3D model. The user selects one of 5 primitives at the top: cylinder, cone, sphere, straight generalized cylinder, bended generalized cylinder and cuboid and places it near the sketch where the primitive needs to fit. The software automatically infers the lines of the sketch where the object fits and snaps the primitive to the annotated by the program part of sketch.
Each of the primitives is defined by two category of curves, the feature curves and the silhouette curves. The whole sketch is initially processed and automatically infer the silhouette and feature curves of the sketch. When there are misses of this automatic process the system allows the user to correct these possible misses. While dragging one of the primitives the system automatically matches the feature and silhouette curves of the primitive to the feature and silhouette curves of the sketch. Also while dragging the primitive on the sketch the system automatically produces a snapped preview on the sketch and if the user is satisfied he/she can release the mouse button and let it finally snap on the sketch.

Each of the primitives is represented by a parametric function holding the parameters of the primitive and a set of constraints that the parameters should have. For instance in a cylinder one of its parameters is a normal pointing to where the cylinder is looking and a constraint is that this normal should have norm value 1. While snapping the object these function with the constraint is minimized so that it fits with the curve. This minimization is non-linear and has equality constraints and is solved with the augmented Lagrangian minimization process.

When the user is building the model adding more primitives, the system automatically creates annotations like collinearity, orthogonality with all other primitives existing in the system and adds them to the whole minimization process when the user releases the button allowing the primitive to finally snap. When this happens the system is minimizing the whole scene including the annotations, thus creating a plausible view of the final model. The interested reader can further read about this work in [8].

2.1.4 Acceleration of Sketch Interpretation using the GPU

The whole minimization process of Section 2.1.3, when a lot of primitives and annotations are present, is very slow. One of the tasks of a Bachelors student I supervised was to accelerate this process using the GPU, i.e. accelerating the minimization process when the user releases a primitive. As mentioned in Section 2.1.3 the minimization is non-linear with equality constraints (constraints of the primitives and annotations) and is solved with the augmented Lagrangian minimization process. The augmented Lagrangian needs to calculate the gradients of complex functions and for this purpose automatic differentiation is used [9]. Recent advances in algorithmic development of automatic differentiation in GPUs allows the process of automatic differentiation to be done on them.

The whole proposed algorithmic development of automatic differentiation was to create in the GPU a Grid
of threads existing on two dimensional blocks. In each block the gradient with respect to one parameter was calculated. Specifically in each block of the first dimension all the functions, constraints and annotations were hosted while on the other dimension all the parameters that they hold was hosted. So each block of threads did automatic differentiation on a specific function or constraint or annotation under a specific parameter. This Bachelors Thesis finished in July 2014.

2.1.5 Acceleration of Surface Reconstruction using the GPU

Surface reconstruction is the process of creating a 3D polygon mesh out of a given 3D point cloud, usually equipped by the normal information on them. Surface reconstruction received a lot of attention from mid-nineties and still is a topic of active Research. One of the most popular surface reconstruction algorithms is the Poisson surface reconstruction [10].

The approach in [10] constructs the indicator function $\chi$ which is a function that receive zero value everywhere except inside the surface of the object that receives the value 1, see Figure 2.4(a). The gradient of this indicator function is zero outside and inside the object and non-zero only on the surface. Its gradient on the surface have the same direction as the normals, see Figure 2.4(b),(c).

![Figure 2.4: (a) Indicator function, (b) points and normals, (c) Indicator function gradient.](image)

To find the indicator function, the gradient minus the normal information is minimized, i.e. $\min_{\chi} ||\nabla \chi - \vec{V}||$. By taking the divergence, the problem is transformed into a standard Poisson problem:

$$\triangle \chi = \nabla \cdot \nabla \chi = \nabla \cdot \vec{V} \quad (2.1)$$

In order to solve the Poisson problem a discretization of the space is followed based on adaptive octrees, i.e. the adaptive octree will adapt to the point cloud distribution avoiding in each level splitting on areas where there are no points inside the octree node, see Figure 2.5(a). In each of the nodes a smoothing function will be defined and convolved with the Poisson equation. This function is multi-scale in the sense that it depends on the width of every node in the octree. The linear combination of these functions on all nodes produce the indicator function by solving the discrete Poisson problem hierarchically, see [10] for more information.

The current state of the art [11] in accelerating the Poisson surface reconstruction in the GPU uses a bottom up approach to build the octree. My Master student offered a complete solution of this approach. Future
direction will present a top down approach using the recursive capability that then new CUDA API offers on recent GPU processors. To our knowledge this has not been done since now for the specific task of surface reconstruction. See Figure 2.5(b) for a reconstructed mesh using adaptive octrees on the GPU at depth 10. The reconstruction of the more than 3 million point input takes much less time than the cpu reading the 3D points from the text file. This Master Thesis finished in September 2014.

2.1.6 GPU implementation of particle simulation

Particle simulation in the GPU is a well studied field. A lot of research papers have appeared on this field during the past years. My Master student focused on developing a particle simulator based on a recent work [12].

In particular the uniform grid based approach will be used to simulate the particles [12]. In this philosophy the Grid of the CUDA environment is split in three dimensional blocks in which the particles are indexed. Once the particles are indexed then they can be processed adding velocity, friction, gravitational forces,
collisions and other forces. Figure 2.6 displays the demo that my Master student created, implementing [12] adding speed and collisions on the particles with each other and the surrounding cube. With my Master student we offered a prototype theory to distribute the uniform grid that the space is divided to different GPUs or to the same GPU using the recent HyperQ technology. This Thesis finished in September 2014. Future directions is to evaluate the distributed theory we propose and see how the size of the simulation can defeat the communication costs which is necessary when a multi-GPU setting is used.

2.1.7 Hyperspectral imaging for endmember extraction using the Minimum Volume Simplex Analysis algorithm (MVSA)

![Hyperspectral image](a) Hyperspectral image
![Hyperspectral image acquisition](b) Hyperpectral image acquisition

Figure 2.7: Hyperspectral imaging.

A hyperspectral image is a 3D image. On the plane domain are the pixels on a specific spectral length and on the depth domain are the different spectral lengths. Usually it is represented as a cube, see Figure 2.8(a). A hyperspectral image is acquired by an airborne (in a plane) or spaceborne (in a satellite) sensor scanning the ground, see Figure 2.8(b). A crucial application is to acquire the signatures (spectra) of the different material that the ground consists. This process is called Hyperspectral Unmixing (HU).

In my research at the HOST project I got involved in the linear unmixing model. This model assumes that the hyperspectral pixel vectors are a linear combination of a mixing matrix $M$ which represent the distinct signatures that the hyperspectral cube consists, called endmembers, and a fraction matrix $S$, called abundance matrix, which represent the percent of these signatures that are present in the scene.

Let the data spectral vectors $Y \equiv [y_1, \ldots, y_n] \in \mathbb{R}^{p \times n}$ be a matrix holding in its columns spectral vectors $y_i \in \mathbb{R}^p$, for $i \in \{1, 2, \ldots, n\}$ for a given hyperspectral data set, where $p$ is the number of endmembers and $n$ is the number of pixels. We assume that a dimensionality reduction step is applied to the data such that the vectors $y_i \in \mathbb{R}^p$ are the coordinates of the original vectors with respect to a basis of the subspace spanned by the original measured vectors. Under the linear mixing model, we have

$$Y = MS + W$$

s.t.: $S \geq 0$, $1_n^T S = 1_p^T$,  \hspace{1cm} \text{(2.2)}

where $M \equiv [m_1, \ldots, m_p] \in \mathbb{R}^{p \times p}$ is the mixing matrix ($m_i$ denotes the $i$-th endmember signature and $p$
The main computational bottleneck of this algorithm is the quadratic optimization that it involves. A pseudocode of sequential quadratic programming is shown in Algorithm 1.

Algorithm 1 Pseudocode of sequential quadratic programming

1: INPUT: \( A_I, A_E, b_I, b_E, q_0 \)
2: Convergence \( \leftarrow \) false
3: repeat
4: Compute \( \nabla^2 f(q_0), \nabla f(q_0) \)
5: \( q \leftarrow \) solution of the quadratic optimization (2.4)
6: if \( f(q_0) < f(q) \) then
7: do line search until \( f(q_0) > f(q) \)
8: end if
9: if \( |f(q_0) - f(q)| < \text{threshold} \) then
10: Convergence \( \leftarrow \) true
11: end if
12: \( q_0 \leftarrow q \)
13: until Convergence

The main computational bottleneck of this algorithm is the quadratic optimization that it involves. \( A_I \) is of the order \( Np \times p^2 \) which on a reasonable size of image greater than 350 \( \times \) 350 pixels with \( p = 19 \) endmembers becomes extremely large and consume a lot of memory to store it. Moreover the computational complexity of optimization algorithms using it directly is very large. My research was to make the quadratic problem less complex. For this I used the interior point method [13]. This method can receive a normal form in solving the Newton step but still involves the use of the large matrix \( A_I \). So I have proceeded further into transforming the matrix into a compact representation of size \( Np \times p \) thus reducing the size \( p \) times. All operations are done using this compact representation and other transformations which do not require the use of \( A_I \). The reduction in memory requirement after applying these transformations was dramatic, from 5GB in a real image to 500MB. Also the speedup was also dramatic making the algorithm hundreds of time faster than its previous implementation in Matlab. This research has been submitted and accepted under revision to the Journal *Transactions on Geoscience and Remote Sensing* [14].
Table 2.1: Processing times, MPI times, I/O times and speedups with regards to: a) 1 GPU, b) a multi-threaded, and c) a single-threaded MKL implementation of MVSA that exploits the 8 cores available in the considered system. The multi-threaded implementation took 52 seconds and the single-threaded implementation took 85 seconds to complete 150 iterations of the interior-point algorithm.

<table>
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<th>Number of GPUs</th>
<th>Application time [secs]</th>
<th>Mean MPI time [secs]</th>
<th>Mean I/O time [secs]</th>
<th>Speedup with regards to 1 GPU</th>
<th>Speedup with regards to 8 CPU cores</th>
<th>Speedup with regards to 1 CPU core</th>
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<tr>
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<td>0.21</td>
<td>5</td>
<td>9</td>
<td>21.1</td>
</tr>
</tbody>
</table>

2.1.8 Multi-GPU Implementation of the Minimum Volume Simplex Analysis Algorithm for Hyperspectral Unmixing

In Section 2.1.7 an optimization strategy was developed to solve the quadratic problem (2.4) requiring significant less memory and computation. As a second optimization, I have used graphics processing units (GPUs) to effectively solve (in parallel) the quadratic optimization. As a third optimization, I extended the single GPU implementation to a multi-GPU one, developing a hybrid strategy (MPI and CUDA) that distributes the computation while taking advantage of GPU accelerators at each node. The optimizations were tested in different analysis scenarios (using both synthetic and real hyperspectral data) and shown to provide state-of-the-art results from the viewpoint of unmixing accuracy and computational performance. The speedup achieved using the full GPU cluster compared to the CPU implementation was 20 times faster in a real hyperspectral image.

In the hybrid implementation a lot of aspects had to be resolved. The most important was to reduce the memory transfer between the MPI nodes (each node is an IBM blade consisting of one NVIDIA TESLA M2070Q GPU). So a lot of consideration apart from the acquired speedup was given to the I/O from host to device and vice-versa and the communication time. Table 2.1 displays various timings, the application time which is the real time the interior-point algorithm was run without communication taken into consideration, the MPI time which is the communication time, the I/O time and the relevant speedup. From this Table it can be observed that the communication and I/O is less than 10% leaving the GPUs to do computational tasks at about 90% of the time. This is a significant achievement since communication and I/O has been reduced to the absolute necessary, conforming this way with the ideal case of Parallel Programming. Also using all the GPUs available I succeeded to achieve 4 times speedup over 1 GPU, 34 times speedup over a single threaded version of the interior point algorithm and 21 times speedup over a multi-threaded implementation of the interior point algorithm. This Research has been published in JSTARS [15].

2.1.9 Robust Minimum Volume Simplex Analysis for Hyperspectral Unmixing

As mentioned in Section 2.1.7 the optimization problem of MVSA (2.3) does not take into account the presence of noise. In the presence of noise the simplex found by MVSA is larger than the real one. In order to accommodate the presence of noise, inspired by the recent work of RMVES [16], we have added chance constraints to MVSA, transforming the problem (2.3) to:

\[
\hat{Q} = \arg \min_Q -\log |\det(Q)|
\]

s.t.:

\[
q_i^T y_n \geq \Phi^{-1}(\eta) \sqrt{q_i^TDwq_i},
\]

\[
1^p Q = a, \forall i \in \{1, \cdots, p\}, \forall n \in \{1, \cdots, N\},
\]

(2.5)
where $\Phi(\cdot)$ denotes the cumulative distribution function of the standard normal random variable (Gaussian random variable with zero mean and unit variance), $q_i$ denote the column vector formed by the $i$th row of $Q$ and assume that the noise random vectors $w_i$, for $i = 1, \ldots, N$, are Gaussian distributed with zero mean and covariance matrix $D_w$.

The problem (2.5) has non-linear constraints. With the help of the partners in Spain we have managed to linearise the constraints and effectively use the same algorithms as MVSA to solve the problem. This work was accepted at the EUSIPCO 2014 conference [17], see Figure 2.8(a) for a demonstration of how chance constraints relax the non-negative constraints of MVSA fitting the simplex closer to the true endmembers and Figure 2.8(b) for a demonstration of how RMVSA receive better endmember estimates than MVSA. Currently a Journal paper is prepared to submit a significantly improved version of our Conference paper.

2.1.10 Multi-GPU implementation of the Fuzzy C-Means and Spatial Fuzzy C-Means algorithm

During the first month I joined the HOST project at University of Timisoara I got involved in accelerating the fuzzy C-Means algorithm (FCM) and its derivative Spatial Fuzzy C-Means algorithm (SFCM) using two NVIDIA TESLA GPUs in CUDA. I succeeded in completing the task and offered solutions which are in
direct comparison with a Blue Gene P super computer, see Figure 2.9 for an illustration of the output of both algorithms on a satellite image. The whole multi-GPU philosophy was presented in the HOST workshop on HPC services (http://host.hpc.uvt.ro/events/wohs/) held in conjunction with the SYNASC 2012 conference.

2.2 Junior Collaborators

From my PhD onwards I collaborated with the following students

• **Ioannis Pechlivanidis.** I did partial supervision of Mr. Ioannis Pechlivanidis while I was doing my PhD. His Bachelors topic was on surface segmentation (see Section 2.1). Specifically his task was to implement and investigate an already published paper [18]. In our meetings I was always helping him with the implementation of the algorithm and was answering him all the questions the paper generated.

• **Alex Shtof.** During my Post-Doc in Israel I collaborated with the Master student of Prof. Daniel Cohen-Or, Mr. Alex Shtof. Our task was completing the graphical user interface he started on sketch interpretation in C#, see Section 2.1.3. With Mr. Shtof we cooperated closely by dividing the various tasks that the UI required and then joining them together. Our cooperation was very good and resulted in the publication of our joint work [8].

• **Cristian Viorel Pasat, Chris Ochinca.** Mr. Cristian Pasat got acquainted with me when I wanted a case study of users running the interface I created with Mr. Shrof (see above). I soon saw his commitment and well behaviour and that he had potentials to advance the software further. Mr. Chris Ochinca got introduced to me by a colleague in UVT as he was searching for a project to get involved. Mr Pasat was then in his second year of Bachelors study and Mr. Ochinca was in his year of his Bachelors. I saw the potential of them cooperating together and have assigned them the project of Section 2.1.3 under my guidance. I also got them involved in the Masters Parallel Programming course I was teaching to get acquainted with Parallel Programming. I took them also both with me at the Multicore Summer School held at Rome from the “Tor Vergat” University. The topic of Section 2.1.3 was also Mr. Pasats Bachelor Thesis topic under my Supervision and he cooperated with Mr. Ochinca and the Bachelor was completed in July 2014.

• **Alexandru Bledea.** Mr. Bledea was known to me from his attendance of the Masters Parallel Programming course I was teaching and still do this year. From his attendance of the course I noticed his strong commitment to the course and that he had potentials to complete the topic in GPU programming of Section 2.1.5, thus I asked him to do this Master Thesis with me which he accepted. Mr. Bledea was enthusiastic and satisfied with my Supervision. His task was difficult but with my Supervision, his determination and abilities he finished his Thesis on time in September 2014.

• **Farcas-Neamt Octavian.** Mr. Octavian started his Masters Thesis Topic with me in September 2013. He previously took the course of Parallel Programming with me. In the course I noticed that he is very bright and had a lot of potentials. When he took the exam for the second time to improve his grade he asked me if I can supervise him because he thought I was the most approachable and well cooperative person who could think for doing his Masters. I accepted him and had given him the topic of Section 2.1.6. He completed the Thesis on September 2014.

• **Jorge Sevilla Cedillo.** With Mr. Cedillo (soon a Dr.) we got acquainted while he was in Timisoara in October 2012. We immediately had conversations on his Research interests which are now also part of my Research interests, specifically on Hyperspectral Imaging. Mr. Cedillo is a PhD Candidate at the University of Extremadura under the Supervision of Prof. Antonio Plaza. Mr. Cedillo introduced me with Prof. Plaza with whom a very intense cooperation started.
2.3 Senior Collaborators

Since my PhD I have collaborators with the following Professors:

- **Stavros Perantonis, Ioannis Pratikakis, Nicholas S. Sapidis, Philip Azariadis.** Prof. Perantonis, at N.C.S.R Demokritos, was the first to contact me while I was doing my Military service and invited me to audition for a PhD. After successful auditioning I got assigned as my PhD topic the European Union funded project “Part based 3D representation for the retrieval of 3D graphical models”. For its completion I collaborated closely with Prof. Pratikakis and also was extremely helped by Prof. Sapidis and Prof. Azariadis at the University of the Aegean. Our cooperation was very successful and leaded to me finishing my PhD with excellence and also in the publication of well cited papers.

- **Ariel Shamir, Daniel Cohen-Or.** In June 2011 I contacted Prof. Shamir in Israel (at the Efi Arazi school of Computer Science at the Interdisciplinary Center) asking him for a Post-Doc position. Prof. Shamir response was immediate and he offered me a Post-Doc position. Prof. Shamir later introduced me with the very famous Professor Daniel Cohen-Or at Tel Aviv University. They both became my Post-Doc Supervisors and guided me to finish successfully the project of Section 2.1.3. Both have been my mentors and taught me discipline in Computer Science and to overcome my fears with hard work. Also Israel is a very disciplined Country and I got taught from it discipline in life.

- **Yotam Gingold.** With Prof. Gingold (at George Mason University) we got acquainted by Prof. Shamir and Prof. Cohen-Or while I was working on the Sketch Interpretation software with Mr. Shtof. He soon became a good partner and I collaborated with him closely towards the completion of the project.

- **Dana Petcu.** With Prof. Petcu we got acquainted when I was searching for a new position in June 2012. I came across in the Internet that she was seeking a researcher for the European Union funded project HOST. I contacted her applying for the position and her response was positive immediately. After successful auditioning to her over the Internet I joined the HOST team in September 2012. With Prof. Petcu our cooperation is very good and she is a co-author of our jointly published work [15] of Section 2.1.8.

- **Daniela Zaharie.** With Prof. Zaharie we first got acquainted while I gave my interview with Prof. Petcu. When I first got in Timisoara working for the HOST project she participated in the project of Section 2.1.10 and helped for its completion. She also was a very live listener of my Research of Section 2.1.7 and have given valuable advices. She is the co-author of the paper [14].

- **Antonio Plaza.** With Prof. Plaza, at University of Extremadura, we got acquainted by Mr. Cedillo while he was here in Timisoara at UVT. Immediately we began a very live cooperation and he was the one that proposed me to work on the problem of Section 2.1.7. In my visit at Spain at his University on January 2013 and on January 2014 we were able to work more closely and our cooperation was flawless. He is the co-author of the submitted paper [14], the paper [15] of Section 2.1.8 and the paper [17] of Section 2.1.9.

- **Jun Li.** I got introduced to Prof. Li, at School of Geography and Planning, Sun Yat-Sen University, Guangzhou, P. R. China, by Prof. Plaza while I was working on the project of Section 2.1.7. With Prof. Li we immediately established very good communication advancing the project to the state of being ready to be sent for publication. While I was in the University of Extremadura in January 2014 we had the chance to cooperate in a common place and produced the project of Section 2.1.9. She is also a co-author of the paper [15] of Section 2.1.8.

- **José M. Bioucas-Dias.** To Prof. Bioucas, at Instituto Superior Técnico, I got introduced by Prof. Plaza and Prof. Li. During our communication we had a very good and solid understanding of each
other and he offered valuable advices on aspects of Hyperpectral Imaging. Prof. Bioucas is also a co-author of the paper [17] of Section 2.1.9 and the paper [14] of Section 2.1.7.

2.4 Lectures

Giving lectures is a vital activity for a researcher. This way he/she can communicate with colleagues, inform them about his/her current research and receive valuable feedback. From my PhD onwards I have given a lot of lectures at the following institutes/universities:

- **Institute of Informatics and Telecommunications, N.C.S.R. Demokritos.** While I was doing my PhD I have given over than 3 lectures on my PhD Thesis.
- **Department of Product and Systems Design Engineering.** During my PhD I have given a lecture about my PhD thesis while it was finishing.
- **Tel Aviv University, department of Informatics** During my Post-Doc I have given two lectures at Prof. Daniel Cohen-Or Computer Graphics seminar.
- **Department of Mathematics and Informatics, West University of Timisoara.** During my stay at the University of Timisoara I have given so far 2 lectures at the scientific seminars of the department and also two lectures in the HOST workshop on HPC services (http://host.hpc.uvt.ro/events/woha/), and in the HOST Workshop on HPC for Scientific Problems (http://host.hpc.uvt.ro/events/hpcsp/) in conjunction with SYNASC 2012, SYNASC 2013 respectively.
- **Department of Technology of Computers and Communications, University of Extremadura.** I have given at University of Extremadure a lecture about the project of Section 2.1.7.

2.5 Outlook

While it is difficult to predict future research since the whole process is very dynamic because new ideas may come and new collaborations that may drive your research elsewhere, I believe that so far I have done a lot of Research to have a vision of the future. First of all in Computer Graphics I have done an extensive research as shown in the research highlights. All of the projects have possible extensions and may be advanced further. My knowledge in Hyperspectral Imaging is a valuable asset and my cooperation with people on this topic will continue generating new projects. Also my continuously enrolment in high performance computing will bring new projects that need acceleration with the new hardware accelerators of the market and also generate new theory specifically tailored for this hardware. So my vision is to use all of my knowledge to derive new projects in Computers Graphics, Hyperspectral Imaging, extend existing projects and also coming up with new projects which need high performance computing.

3 Teaching Statement

Being a good Teacher does not necessarily come if you are a good Researcher. While you are doing Research you and your partners have a specific level of knowledge and the communication is up to the Researcher hav-
ing good and disciplined social skills. With Students a Researcher is not at the same level and he/she can’t expect that the students will have the level he/she requires. Being able to transfer knowledge to students is a function of many factors. The first aspect that a Teacher should have is good communication skills so as to be able to approach every students mind directly. The second key aspect is the teacher to have good knowledge of psychology so as the student to be able to attend his/her course and feel comfortable. All of my students see me as a person who they can approach and talk. This is the way I got my Bachelors and Masters students trust and did with me their Thesis. A right Teacher should also know where to put the proper barriers so that mutual respect to exist.

3.1 Courses I taught at UVT and Summer Schools

My teaching responsibilities here at the University of Timisoara and at Summer Schools were:

- **Masters Parallel Programming Course.** I have taught successfully the Masters Parallel Programming course at the West University of Timisoara (UVT) the spring period of 2013 and spring period of 2014. The topics that I taught was general theory about parallel programming, MPI programming, CUDA and OpenMP. In my teaching I follow an interactive approach. I am teaching the students how to have a critical thought on Parallel Programming. The gap of going from serial to parallel programming is called a “ninja gap” by many people and with a good reason. Thinking in parallel from a serial background requires a lot of effort and the teacher’s responsibility is to assist the student in this effort. For this reason I am making them have a hands on approach with a computer. I am posing the parallel problem, let the students think and then tell them to write the program in the computer. To each student I am attending and helping him/her at the points he/she gets stuck. This way the student understands better the problem and gets deep into parallel programming. All of my students have given me a positive feedback after they finished the course telling me that the way I was teaching them, made them understand parallel programming.

- **Teacher at the Multicore Summer School, University of Rome ”Tor Vergata”**. This summer school (http://multicoresummerschool.uniroma2.it/) took place in July 2013 and I was appointed one of its Teachers. The topics that I taught was Parallel Programming with MPI and CUDA and also taught the topics of Section 2.1.7 and Section 2.1.8.

- **Teacher at creaTIVE Summer School, Universitatea OVIDIUS din Constanta**. This Summer School (http://creative.cerva.ro/) took place in Constanta, Romania in August 2013. At this school I taught successfully the topic of Section 2.1.5.

3.2 Supervision of Students

Apart from teaching a vital activity of a successful teacher is to supervise students. Supervising students is a challenging task. It requires teaching, mentoring, guidance and communication skills. When you introduce the topic to your students you need to prepare it also to present it in a way that the student will understand it and at the same time create a critical thought on the subject in order to offer a possible novel solution with your guidance. The whole ritual of creation of a Thesis in the Masters and Bachelors level is the student to finish with a satisfaction that its his/her own work although your intervention have lead him/her to finish the Thesis. At the University of Timisoara I had the opportunity to supervise two Masters and one Bachelors student.
3.2.1 Supervision of Master students

My two Master students (Alexandru Bledea, Farcas-Neamt Octavian, see Section 2.2) have approached me with a will to do a challenging topic and they were certain that I can offer to them the proper mentoring to complete the Thesis. Thus I had trusted them with the topics of Section 2.1.5 and Section 2.1.6. Doing supervision of these topics was rather challenging because the degree of their difficulty is high, especially for topic of Section 2.1.5. This topic required a lot of Mathematics. Making an Informatics student acquainted with Mathematical concepts is difficult and you need to break the ideas in little pieces feeding them to the Student’s mind. The first reaction of my student when he saw the Maths was to quit but with my persistence, tutoring and analysis he finished his Thesis successfully. As I told in the introduction of this Section 3.2 the student should always feel the satisfaction of doing the Thesis by himself and my students gave me this feedback.

3.2.2 Supervision of Bachelor students

The level of the Bachelors degree is different than the level of the Masters degree. The Bachelor student is still under the influence of high school and become slowly a Scientist. So there is a special need to be approachable by him and offer advices that enhance his/her understanding on the selected subject. My two Bachelor students (Cristian Viorel Pasat, Chris Ochinca, see Section 2.2) that were working on the project of Section 2.1.4 had the opportunity being under my guidance at an early stage. I have introduced them into parallel programming through my lectures, they successfully passed the examination and attended the multicore summer school in Rome. They reached to the stage of fully taking control of the project of Section 2.1.4 under my guidance and completed the project.

3.3 Outlook

Having acquired this experience in teaching and supervision I strongly believe that I am well fitted to enter into the Academic staff of a University and confident that I will succeed in teaching various courses in Computer Science and also guide student in their Thesis as a Supervisor.

References


