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| Pegasus%20-%20Black%20on%20White | | | | Department of Electrical Engineering & Computer Science, CS Division  College of Engineering & Computer Science  University of Central Florida | | | | | | |
| *Return Form to*: Dr. Mark Heinrich, heinrich@cs.ucf.edu | | | | | | |
| **COP 4934: Computer Science Senior Design** | | | | | | |
| **Proposed Project Description Form\*** | | | | | | | | | | |
| (Sponsors who are willing and able are asked to provide a Team Donation of $1500 or more for supplies and the running of the CS Senior Design Program) | | | | | | | | | | |
| Will support: Amount TBD Cannot support: | | | | | | | | | | |
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| Sponsoring Organization: | | | | | | AMD Inc. | | | | |
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| Mailing Address: | | | 3501 Quadrangle Blvd, Suite #375, Orlando, FL 32817 | | | | | | | |
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| Project Contact: | | Mangesh Nijasure | | | | | | Position: | | Senior Member of Technical Staff |
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| Contact Phone: | 407-541-6857 | | | | | | Fax: | |  | |
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| Contact E-mail: | [mangesh.nijasure@amd.com](mailto:mangesh.nijasure@amd.com) | | | | | | | | | |
|  | | | | | | | | | | |
| Project Title *(working)*: | | | | | Parallel Tessellation Using Compute Shaders | | | | | |

*Please feel free to use as much space as needed for each of the sections below.*

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| **Background of Company/Organization**  (Provide a brief overview of the company/organization and the specific project location here) |
| AMD delivers unique and unmatched computational capabilities in order to create natural, intelligent and innovative ways for people to interact with the devices they love. We design and manufacture  graphics cards and microprocessors that power millions of the world’s personal computers, tablets, gaming consoles, embedded devices and cloud servers.  AMD has a history of making next-generation technology accessible to millions, bringing feature-rich computing solutions to the world at the right price. We also design technology with a higher level of visual computing capabilities than previously imaginable—with features like 3D graphics and UltraHD visual resolution, as well as accurate and reliable voice and facial recognition, touch and gesture control.  All major video game console manufacturers use AMD semi-custom technology. Fantasy, imagination and competition come to life in the games of today and tomorrow because creators enjoy unprecedented freedom with technology. We partner with all major console manufacturers, including Sony, Nintendo and Microsoft, to deliver semi-customized processing solutions as unique as the consoles they power. AMD’s semi-custom chip technology is in the groundbreaking new Sony PlayStation® 4 and  Microsoft Xbox® One, driving breathtaking image quality to deliver truly out-of-this-world gaming experiences.  AMD’s Orlando office has been in the area since 1998 (initially as ATI Inc). This site primarily focuses on designing Graphics IP that is used in all AMD silicon for discrete graphics, APUs as well as semi-custom solutions like the game consoles. AMD has pursued several research projects/grants with UCF over the years and have a very high number of UCF interns who have transitioned to full time employees.  [www.amd.com](http://www.amd.com) |
| **Statement and Scope of the Problem(s)**  (Provide the problem statement here; Please be as specific as possible to help us understand the scope of the problem, and thus the scope of the project, specifically the design content) |
| The Dx11 graphics API introduced a way for the user to specify low detail subdivision surfaces as input primitives. These are broken up into higher detail primitives on the GPUs. Most hardware vendors that support Dx11 class of GPUs implement this tessellator as fixed function hardware. This is highly efficient and provides excellent performance but this hardware can only be used for this single task.  The scope of the project is to evaluate an alternate approach to fixed function hardware tessellation using compute shaders that can be run on the GPU. These  Diagram of the Direct3D 11 pipeline that highlights the hull-shader, tessellator, and domain-shader stages  <http://msdn.microsoft.com/en-us/library/windows/desktop/ff476340(v=vs.85).aspx> |
| **Overall Project Goal(s)**  (Describe the overall goals of the project in this space) |
| The high level goal for this project is to implement the entire tessellation logic as a compute shader. This will include various levels of analysis to determine if this approach is a feasible alternative to fixed function hardware. Primarily by comparing the performance of each approach. The section below provides detail on all the steps involved. |
| **Project Objectives**  (Enter the project objectives that will help achieve the goals of the project; Please be as specific as possible) |
| The tessellator has several input parameters.  Various types of patch domains. This is the type of subdivision patch that is being tessellated   * Triangle * Quad * Isoline   Different partitioning types. These are variations in the patterns in the post tessellation vertices   * Even * Odd * Integer * Power of 2   Tessellation factors. This specifies the level of tessellation to be performed   * There is a factor per outer edge * There are 1 or 2 factors for the inside (depending on the domain)   Given these inputs, the tessellator is responsible for generating post tessellation geometry in the form of vertices (represented as barycentric coordinates) and connectivity data.  Each of the domain types and partitioning modes has different math computations and can be parallelized by distributing amongst different team members.  The algorithm itself is too complex to describe in this document, but AMD will provide material and guidance on understanding what is required. We will also provide a reference model that can be used to check accuracy. |
| **Expected Project Deliverables**  (Enter the expected project deliverables including, if possible, proposed project tasks; Please be as specific as possible) |
| The following deliverables are expected   * Working compute shader implementation that can correctly tessellate a given patch for all the supported domains and partition types * Performance analysis evaluating hardware tessellation versus the developed compute shader approach. Each approach should be run on both AMD and NVIDIA hardware. |
| **Desired Core Competencies and Experience of Team**  (Please list the desired competencies/experience/knowledge needed by the project team members that you feel will facilitate successful project execution; Examples: specific programming language experience, familiarity or expertise in certain web technologies, databases, mobile SDKs, prior classes in certain subject areas, a love of computational complexity and efficient algorithms etc.) |
| These are mandatory   * Ability to parse and understand large existing code bases * C/C++ coding skills * Familiarity with the basics of computer graphics * Prior exposure to some GPU shading language and ability to write shader code. Implementation of the project can be done in Open CL or DX Compute.   These are a plus – AMD will provide mentoring as necessary to cover these   * Knowledge of higher order surfaces and the use case for tessellation * Understanding of caches and interaction with parallel threads |
| **Other Special Considerations and Project Requirements**  (Please provide any special circumstances, constraints, and requirements needed by the project team members; **Examples**:   * University participants must be US Citizens or Permanent Residents, * All work is to be performed off-campus at a specific site, * *Interdisciplinary project*: You would like to see CS students teamed with engineering students from one or more of: Computer Engineering, Electrical Engineering, Mechanical Engineering, Industrial Engineering, Civil and Environmental Engineering (please specify) * All team members and the professor must submit to background checks, * All team members and the professor must sign non-disclosure agreements |
| All team members and the professor must sign NDAs ( I will send this out later) . Any code/analysis/conclusions produced will remain the intellectual property of AMD Inc. Any public distribution must be authorized by AMD.  AMD will provide reference hardware (graphics cards) to enable project execution or provide funds to allow students/faculty to procure the necessary cards. |
| **Project Mentor(s), if different than who is listed above**  (Please provide the contact information and title/position for the project mentor(s), who will advise the student team) |
| Please include both the following recipients on any communication/questions regarding the program.  Mangesh Nijasure 407-541-6857 [mangesh.nijasure@amd.com](mailto:mangesh.nijasure@amd.com)  Todd Martin 407-541-6882 [todd.martin@amd.com](mailto:todd.martin@amd.com) |

*\*IMPORTANT NOTE: Proposed projects may not be chosen by student groups. In any one semester the number of potential industry-sponsored, faculty-proposed, or student-funded projects may exceed the number of student teams. If this project proposal is approved by Dr. Heinrich as a potential CS Senior Design project, you or an appropriate representative will be asked to come to class and give a 15-minute project pitch to the students. Keep in mind this is your chance to convince the students why they should pick your proposed project. Think about what is in it for them, what technologies they will get exposed to, what are the broader, enduring, and social impacts of the work, etc. If your project is chosen, you will be notified typically by the 4th week of the semester. If your project is not chosen, you will be notified in the same timeframe and if it makes sense for your timeline, we would love to offer the same project in the next semester.*