On Balancing Energy Consumption, Rendering Speed, and Image Quality on Mobile Devices

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Abstract

Mobile games and other mobile graphics applications have become popular because untethered computing is convenient and ubiquitous entertainment is compelling. However, rendering graphics on mobile devices faces challenges due to limited system resources, such as battery energy, low memory and disk space. Real time frame rates, low energy consumption and high image quality are all desirable attributes of interactive mobile graphics. However, in many cases, achieving these objectives conflicts with each other. For instance, increasing mesh resolutions improves rendered image quality but consumes more battery energy (degrades energy efficiency). Heuristics that intelligently trade off these competing objectives are necessary. We propose a mobile graphics heuristic to minimize energy consumption while maintaining acceptable image quality and interactive frame rates. Over the lifetime of a mobile graphics application, scene complexity, animation paths, user interactivity and other elements all change its CPU and resource demands. We propose a heuristic that dynamically changes scene mesh LoDs and amount of CPU timeslices allotted to the mobile graphics application in order to select optimal operating conditions that balance rendering speed, energy conservation and image quality. We propose a workload predict model so that our heuristic can monitor both application workload and the availability of resources of mobile devices periodically, and adaptively determine how much resources will be allocated to applications. Our experiments show that our heuristic can reduce energy consumption by up to 60% while maintaining interactive frame rates and acceptable image quality.

Bio

Dr. Fan Wu joined the faculty of Computer Sciences Department at Tuskegee University as an assistant professor in 2009. He received his Ph.D. degree in Computer Science from Worcester Polytechnic Institute (WPI) in 2008, M.S. and B.S. in Computer Science from Nanjing University of Posts and Telecommunications, China in 2003 and 2000 respectively. Dr. Fan Wu’s research has been focusing on a broad area of Mobile Graphics, Mobile Computing, High Performance Computing with General Purpose Graphics Processing Units (GPGPU) and Robotics. Dr. Fan Wu’s research work has resulted in 25 book chapters and peer-reviewed technical papers in international journals or conference proceedings and 1 patent application. Dr. Fan Wu worked in Advanced Micro Devices Inc. (AMD) as a senior engineer before he joined Tuskegee University. He mainly focused on the research and development of new generation Graphics Processing Units (GPU) when he was working in AMD. Dr. Wu also serves as a member of editorial review board for International Journal of Handheld Computing Research since 2009.

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