Application Specific Hardware Compression of Ray-Casting Data

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abstract

Ray-casting, that is, calculating the intersections of a large array of lines with a solid object is a well-known technique that is central to many algorithms useful in solid modeling. Ray-casting is a compact and elegant way for displaying and calculating the geometrical properties of 3-D objects. The Ray-Casting Engine RCE-1.5 is an application specific massively parallel computer dedicated to ray-casting 3D objects.

We present an application specific hardware-oriented data compression algorithm. We developed a simple yet powerful data compression hardware specifically tailored to compressing ray-files, the data structure internal to the RCE-1.5.

We have used the compression hardware to meet performance goals while reducing the cost of building the RCE-1.5. We had to balance compression performance on the one hand with real time constraints, development time constraints and hardware costs on the other. With a modest amount of compression hardware we were able to more than double the internal and external data transfer rates. In addition we more than doubled the effective internal memory buffer size. The increase throughput rate enabled us to use (slow but inexpensive) DRAM rather than (faster but expensive) SRAM, dramatically reducing the over-all system cost.

This is but one example where judicious use of data compression techniques can dramatically enhance system performance while at the same time reducing the system cost.