Fast High-Frequency Radar Signature Estimation With Advanced Graphics Machines

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High-Frequency radar signature computation has essentially been used in the airframe industry as one of many key parameters to judge the quality of a preliminary aircraft design. The radar backscatter estimates provide the designer with critical feedbacks in order to optimize the vehicle's exterior configuration, shape, and contour. In this intense engineering work environment, the demand for exceptional throughput from the analysis codes is always premium in order to provide qualitative but timely signature inputs to the multi-disciplinary design process. At the present time, none of the existing codes has yet met this challenge. (Detail designs of major vehicle sub-system are reserved solely for the high-end quantitative Maxwell solvers.)

In 1991, an advanced technique was developed at Lockheed Martin for the computation of physical optics backscattering from large, complex target over multiple frequency bands with unprecedented speed. It took full advantage of the power of the high performance graphic engines for 3D solid surface rendering and shadowing. This method was implemented in a first-generation code VISAGE (Visual Investigation of Scattering in an Advanced Graphics Environment) on the SGI IRIS 4D workstations. The computational throughput is shown to be essentially independent of the target complexity and the desired number of frequencies. In addition, geometrical shadowing of target components is automatically handled. The code combines visual computation with interactive displays, and the tremendous amount of data that VISAGE is capable of generating are easily interpreted through use of multi-dimensional color graphics. In addition, the resultant data set is well suited for use with many sophisticated post-processing algorithms such as ISAR imaging and scattering centers diagnostics and extraction.

In spite of the gain achieved by VISAGE almost twenty years ago, the vision of further improvement to throughput, accuracy, post-processing scheme plus the development of new visual computing applications were largely unfulfilled due to resource limitation and R&D priority of the company. Meanwhile, the computing technology has evolved towards open GPU architecture residing on either the PC or the Linux platforms with SGI fading into the sunset. It is unfortunate that the VISAGE capability is basically unknown to the general technical community and is yet not fully developed and explored. The prime objective of this seminar is to re-introduce this technology to wider audiences and to re-invigorate the desire to investigate visual computing with available advanced GPU. At present, this technology can be easily ported to a graphics PC workstation or to an advanced laptop in the not too distant future.