Workshop on

Fast physical optics modeling with VirtualLab Fusion

Instructor: Frank Wyrowski

Modelling a system with physical optics unavoidably entails solving Maxwell's equations. However, a typical system will contain, apart from the source, any number of disparate components, like lenses, gratings, diffractive elements and waveguides. Unless we are to radically limit the amount and type of components included in a given system, employing a standard Maxwell solver (like FDTD or FEM) to model the entire set-up is, if at all possible, often quite impractical in terms of computation resources, or time, or both. This is possibly one of the reasons to have earned physical optics its fame as a slow and convoluted approach when compared with ray tracing. However, about 10 years ago, VirtualLab software was released, taking the first step towards circumventing these perceived shortcomings of physical optics modelling: the introduction of the concept of field tracing. Already very powerful for paraxial and parabasal sequential modelling situations, its first-generation version can still suffer from high numerical effort when it comes to dealing with non-paraxial fields. But 2017 will see the release of second-generation field-tracing technology, which enables fast, non-sequential physical optics modelling for general systems and fields. VirtualLab Fusion finds all the possible light paths in a system through a preliminary ray-tracing analysis, to then efficiently solve Maxwell's equations for each of those light paths. This efficient solution is found through a cogent combination of diffractive and geometric models for electromagnetic fields in a mathematically well-defined way.

In the workshop the theoretical foundations of second-generation field tracing are presented and illustrated with examples in VirtualLab Fusion. Examples include lens systems with gratings and diffractive lenses, systems with etalons, crystals, graded-index media and waveguide plates for virtual- and mixed-reality applications.