Proposal for Guests, CIRP 2021 Winter Meeting – STC S

Name of the proposed Guest

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Short bio

Jeppe Revall Frisvad is an associate professor at the Technical University of Denmark (DTU). He received an M.Sc.(Eng.) degree in Applied Mathematics (2004) and a Ph.D. degree in Computer Graphics (2008) from DTU. Frisvad has more than 10 years of experience in material appearance modeling and rendering and has, in four research projects, served as leader of work packages focusing on analysis and synthesis of product appearance in manufacturing. As a highlight, his work includes the first directional dipole model for subsurface scattering, and his research on material appearance includes methods for both computation and photographic measurement of the optical properties of materials.
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Motivation

A digital workflow is being introduced everywhere in manufacturing. The digital twin of a product includes a detailed description of the macroscopic 3D geometry of the product. However, when it comes to product appearance, we usually only have an indication of the materials to be used in different parts of the geometry and no detailed information regarding the appearance of these materials. On the other hand, we often investigate the surface microgeometry of a product as this is important with respect to the optical and the mechanical properties of the product. Material appearance is closely linked to optical properties and thus also microgeometry. We should find ways of including representation of the microgeometry in digital twins so that we can predict the expected appearance of manufactured items through simulation. This is necessary for us to render photorealistic images of digital twins. Such predictive rendering has important applications in digital prototyping, quality control, 3D soft proofing, product visualization, improving optical functional materials, etc. We can use it to generate synthetic data sets of the expected appearance of products and use these for training of deep neural networks to recognize a product and assess its quality. The key difficulty in establishing a link between material appearance and microgeometry is validation. We need photographs of objects with known microgeometry to validate our techniques for representing microgeometry and for photorealistic rendering of objects with such microgeometry. Manufacturing of objects with a specific microgeometry is a key challenge in production engineering research. We therefore see great opportunities for synergy between the fields of production engineering and computer graphics in the near future.