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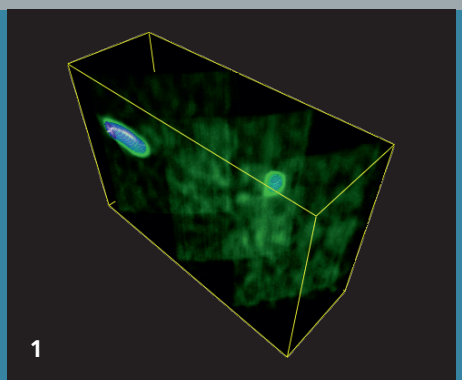
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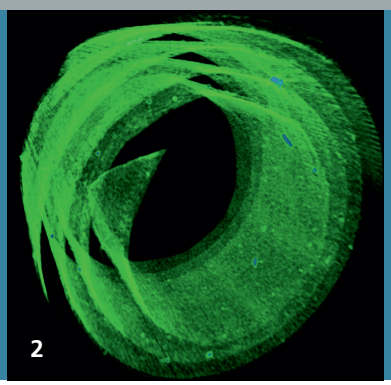
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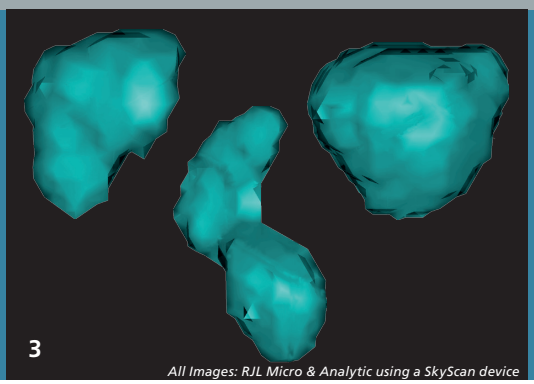
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All Images: RJL Micro & Analytic using a SkyScan device

MAVI

MAVIparticle – MODULAR ALGORITHMS FOR 3d PARTICLE CHARACTERIZATION

MAVIparticle is a software tool for characterizing particles based on 3d images.

MAVIparticle uses from the wealth of MAVI's 3d image processing and analysis methods those particularly suited for quantitative analysis of particle sizes and shapes.

MAVIparticle offers additional size and shape descriptors generalizing concepts from 2d particle analysis unambiguously to the spatial setting.

MAVIparticle is particularly suited for characterizing residual dirt particles in technical cleanliness applications. Size and shape characteristics are measured that allow to identify the particles as granules, chips, or fibres.

MAVIparticle is easy to use thanks to the "button structure".

MAVIparticle allows to detect dangerous dirt particles reliably and with high throughput based on micro computed tomography. It thus enables 3d cleanliness analysis.

MAVIparticle allows the complete analysis of large 3d gray scale data, from segmentation via particles features up to automatic visualization.

MAVIparticle adapts to your requirements interactively using dialogue windows.

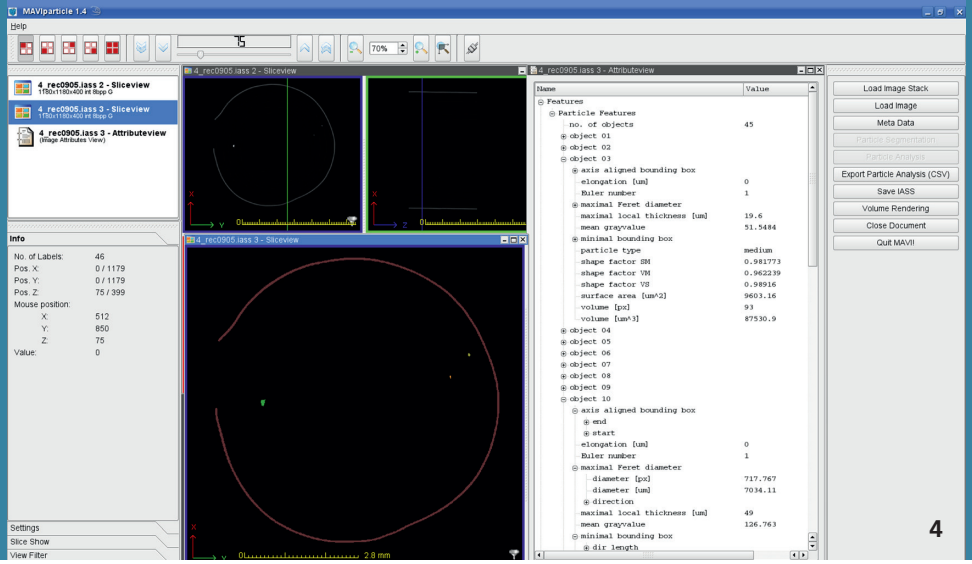
MAVIparticle is compatible with the SkyScan 3d image format but can be adapted to any other CT device's output.

Fraunhofer-Institut für Techno- und Wirtschaftsmathematik ITWM

Fraunhofer-Platz 1
67663 Kaiserslautern
Germany

Contact
Dr. Katja Schladitz
Phone +49 631 31600-4625
mavi@itwm.fraunhofer.de

www.itwm.fraunhofer.de
www.mavi-3d.de



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3d Technical cleanliness

Technical cleanliness refers to the quantitative and qualitative inspection of the contaminants gathering on components during production. In machinery industries, a certain level of cleanliness has to be measured in order to guarantee the expected durability and performance of the assembled products. Dirt particles are collected from the surface of components, imaged microscopically and analyzed based on the 2d image data. However, as tolerances get smaller, parts such as in cars get more and more sophisticated. Hence the demands on cleanliness analysis grow. Micro computed tomography allows to capture the complex 3d shapes completely. A geometric characterization of the particles can be exploited to gain information about the types of contaminants present in the specimen.

Particles in 3d

In 3d, particles can be roughly sorted into three classes: fibres, chips and granules. This classification can be performed on the basis of geometric features. A first descriptor of particle shape is the size, i. e. length, width and thickness. It is defined as the length of the edges of the bounding box with minimum volume and axes arbitrarily oriented. These three characteristics allow already the correct classification of most particles. Nevertheless, for some shapes, e. g. spring-like fibres, length, width, and thickness are not informative. Alternatives are the isoperimetric shape factors obtained as suitably normalized ratios of volume, surface area, and integral of mean curvature. Statistical tests prove that they can be used to reliably classify large objects.

Features of MAVIparticle

Measures of the size of a particle are given by: volume, surface area, length of the edges of the minimum volume bounding box (length, width, thickness), maximal Feret diameter, elongation and maximal local thickness.

While the maximal Feret diameter is the maximal Euclidean distance between two points in the particle, the elongation is the length of the longest geodesic path within the particle. For fibrous objects, it is an approximation of the curve length.

The maximal local thickness decides whether a particle is able to invade a gap or not. It is measured as the diameter of the largest ball contained in the particle. The maximal local thickness thus estimates the thickness of a chip or a fibre, and yields the size of the largest core within the particle. Shape is characterized by the isoperimetric shape factors. Additionally, the elongation index, a suitably normalized ratio of elongation and volume, varies remarkably depending on the particle class.

When exporting the features, a 3d visualization of the largest particles is generated automatically. Volume data are saved as well. The particle features are saved in a comma separated value file compatible with MS Excel and R. In particular, output can be fed directly to RJL Micro & Analytic's MicroReporter for automatic generation of reports conforming to standards in cleanliness analysis.

Optimal system

- Windows 64 Bit / SuSE Linux 64 Bit
- Further OS on request
- Recent Intel Xeon or AMD Opteron processor
- Recent high-end Nvidia OpenGL graphics board
- Monitor resolution ≥ 1280 × 1024
- 8 GB RAM and 500 GB of disc space or more, depending on volumes to be processed

License and support

- Single user floating license
- Update/service contract
- On-site software training and consulting
- Customized software development

1 - 2 *3d reconstruction of the specimen imaged by micro-computed tomography. A few large dirt particles are visible on the rolled filter membrane.*

3 *Magnifications of some dirt particles from the specimen*

4 *MAVIparticle: GUI*