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Session
F-4: Modeling of aluminium processing
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Lecture
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EL3

Simulation of pore content in cast aluminum alloys

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Dendritic pores are omnipresent in cast components and cannot be assessed by simple geometric models. However, they may deteriorate the sustainable load considerably, as local stress enhancement may be quite substantial.
A straightforward way to characterize these pores exists in terms of computer tomography, but it is not feasible to analyze larger batches of nominally identical structures due to the high experimental effort required. Given a certain pore geometry, methods have been developed to classify them with respect to their damage criticality. It is found that the detailed geometrical plays a very important role in particular contour irregularities and internal material bridges.
Geometric variability of these pores calls for statistical descriptors of the pore content of nominally identical structures. Simple variables such as size and shape are clearly inadequate, as they cannot distinguish between smooth and round pores and dendritic pores with multiple extrusions and intrusions. To properly account for the geometric variations of porosity it is proposed to design integral statistical descriptors such as autocorrelation functions. Based on these, populations of locally different porosities can be generated for subsequent mechanical analysis. With this methodology quantitative effects of porosity can be given along with their probability of occurrence, which an essential feature for any risk assessment. In the presentation, the pore simulation methodology based on combinatorial optimization will be given in some detail and possible relation between autocorrelation and pore geometry will be outlined.