People have always been curious to look inside a ‘back box’. Can we ‘see’ inside without opening it? Different imaging modalities have been developed for this, but some of them pose threats to health (X-ray) or are expensive and not portable (MRI). Microwaves can be used to retrieve the size, shape, position and material (permittivity) of the objects in the box in a non-destructive way. First, we add antennas around the box and send microwaves in. The microwaves that are reflected and refracted by the unknown objects are then received by other antennas. Then a difficult (so called ill-posed) nonlinear problem needs to be solved to retrieve the information about the unknown objects. This is done by alternately ‘guessing’ the interior permittivity profile and evaluating its agreement with actual measurements. In particular, we guess a permittivity distribution of the unknown object and simulate the scattered fields. If the simulated scattered fields differ from the measured fields, we update the assumed permittivity distribution and then evaluate again until the difference between the simulated and measured fields reaches the noise level. So, how to update is the key point of the whole reconstruction process. Crucial to use there is regularization, meaning a kind of prior knowledge about general characteristics of realistic permittivity profiles. The regularization function needs to satisfy certain mathematical properties (like convexity) and needs to promote spatial continuity without destroying edges. We designed new regularization functions, which improve much the reconstruction process (see examples in the Figure).