The aim of the conducted research is to develop an original shape optimization method under vibroacoustic criteria within the specific mid-high frequency range. The energy density of the acoustic field in the considered system is the quantity to be optimized. We use the Simplified Energy Method (MES), which gives a solution that only depends on the cavity shape, not on the material properties and doesn't need fine meshes. Firstly, the proposed shape optimization method aims at avoiding the remeshing during the optimization process. Secondly, it has to model the acoustic cavity surface exactly. To achieve this goal, we rely on a transformation function which map a 3D cavity surface on a 2D domain. Hence, the optimization is conducted on this function directly.

In the present contribution, we first demonstrate the viability of our approach by considering a 3D ellipsoid cavity. The transformation function is the projection function mapping a unit sphere on a 2D area. The considered parameters are the radii of the ellipsoid. The energy density is calculated at several points inside of the ellipsoid that are chosen as “test points”. The input power flow (primary source of acoustic excitation) is situated on the part of the boundary whose position remains unchanged during the optimization process to avoid the respiration effect. As a result, the governing equation to calculate the energy density at the test points is defined on the 2D area and depends on two variables, i.e. the ellipsoid radii. The optimization problem consists in minimizing the objective function (related to the energy density) considering constraints equations linked to the geometry of the system (the volume of the ellipsoid must remain constant). At this stage we are not working on developing new optimization algorithm, that is why a standard Matlab optimization function is used for the calculations. The 2D area is discretized once before the first iteration. To study the reliability of the optimization process the constrained condition was reformulated in several ways and the same optimal results were obtained, proving the validity of the solution.

The method developed within the framework of presented study allows one to optmize the vibroacoustic system of arbitrary shape choosing the appropriate transformation functions. To prove this, the cavity modelization with the help of B-spline surfaces will be the next step in our research.