Surrogate modelling and optimization techniques are intended for engineering design in the case where an expensive physical model is involved. This thesis provides a literature overview of the field of surrogate modelling and optimization. The space mapping technique is one such method for constructing and optimizing a surrogate model based on a cheap physical model. The space mapping surrogate is the cheap model composed with a parameter mapping, the so-called space mapping, connecting similar responses of the cheap and the expensive model. The thesis presents a theoretical study of the space mapping technique. Theoretical results are derived which characterize the space mapping under some ideal conditions. If these conditions are met, the solutions provided by the original space mapping technique are minimizers of the expensive model. However, in practice we cannot expect that these ideal conditions are satisfied. So hybrid methods, combining the space mapping technique with classical optimization methods, should be used if convergence to high accuracy is wanted. Approximation abilities of the space mapping surrogate are compared with those of a Taylor model of the expensive model. The space mapping surrogate has a lower approximation error for long steps. For short steps, however, the Taylor model of the expensive model is best, due to exact interpolation at the model origin. Five algorithms for space mapping optimization are presented and the numerical performance is evaluated. Three of the algorithms are hybrid algorithms. Convergence of a class of hybrid space mapping algorithms is proved.