Modelling the contact between assembled parts is a key point in the design of complex structures. Uncertainties at the joint parameters arise as a result of randomness in physical properties such as contact surface, load distribution or geometric details. This is a challenge of concern in the hearing aid field, where the small lightweight structures present vibration modes at frequencies within the hearing range. To approach this issue, a model of contacts based on lumped elements is suggested. The joint parameters are the stiffness of a series of spring elements placed along the contact surface, which are obtained by minimizing the least squares distance between experimental and modelled modal frequencies of the complete structure. A key point of the method is the reduction of the size of the system by means of a substructure synthesis method, which reduces the computational cost of the optimization. Another strong point is that an experimental modal analysis of the structure is not required, but only the resonant frequencies and deflection shapes are needed. A case study where the contact between two assembled plastic parts is examined is presented. The variability of the resonant frequencies of the assembly due to changes in the physical properties of the contact is characterised by means of experimental measurements. The distributions of the identified contact model parameters are found to be related to the variability of the resonant frequencies.