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ON CONTACT SHAPE OPTIMIZATION PROBLEMS RELATED TO DISPLACEMENT CONTROL

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Abstract: The problem is related to control of same point displacements of a loaded structure by applying the interacting punch loading. As at the controlled points the displacement and the force are prescribed, a new type optimization problem is formulated. The solution method of this problem can be used for the design of robot elements, such as clippers and gardening or plantation tools for mechanical processing. It is assumed that strains are small and the materials of the contacting bodies are linearly elastic. This problem in the lecture will be demonstrated by considering several cases, namely 1. a cantilever beam clamped at its end and loaded at point Q by the force F, 2. the beam and its support are allowed to execute the rigid body vertical displacement, 3. the beam is allowed to execute the rigid body vertical displacement and rotation. In this case, the displacements are prescribed at two points. In all cases, the control of the deflections at given points is made by the lateral stamp action inducing the resultant load. The stamp contact form is specified for a given distribution of contact tractions between the stamp and beam subject to constraints of fixed values of displacements ui and forces Fi at the points Qi of the beam. In the solution of the optimization problem, first, the value of rigid body displacement of the beam is calculated and from contact conditions between the punch and beam the rigid body punch displacement is specified, which may be used in the mechanical technological process. Using the Green function for the beam, the displacements can easily be expressed for different forces and contact stresses. In these contact optimization problems, the initial gap (shape form of the contact surface) is the unknown function. The problem is discretized and the calculation of the contact shape can be performed by applying the iterative procedure described in [1,2].

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