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Abstract: A previously developed model is used to numerically simulate real clinical cases of the surgical correction of scoliosis. This model consists of one-dimensional finite elements with spatial deformation in which (i) the column is represented by its axis; (ii) the vertebrae are assumed to be rigid; and (iii) the deformability of the column is concentrated in springs that connect the successive rigid elements. The metallic rods used for the surgical correction are modeled by beam elements with linear elastic behavior. To obtain the forces at the connections between the metallic rods and the vertebrae geometrically, non-linear finite element analyses are performed. The tightening sequence determines the magnitude of the forces applied to the patient column, and it is desirable to keep those forces as small as possible. In this study, a Genetic Algorithm optimization is applied to this model in order to determine the sequence that minimizes the corrective forces applied during the surgery. This amounts to find the optimal permutation of integers 1, ... , n, n being the number of vertebrae involved. As such, we are faced with a combinatorial optimization problem isomorph to the Traveling Salesman Problem. The fitness evaluation requires one computing intensive Finite Element Analysis per candidate solution and, thus, a parallel implementation of the Genetic Algorithm is developed. Copyright (C) 2010 John Wiley & Sons, Ltd.

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