First, basic aspects of interval analysis, roles of intervals and their applications are addressed. Then, various classes of interval matrices are described and their relations are depicted. This material forms a prelude to the unifying theme of the rest of the work – solving interval linear systems.

Several methods for enclosing the solution set of square and overdetermined interval linear systems are covered and compared. For square systems the new shaving method is introduced, for overdetermined systems the new subsquares approach is introduced. Detecting unsolvability and solvability of such systems is discussed and several polynomial conditions are compared. Two strongest conditions are proved to be equivalent under certain assumption. Solving of interval linear systems is used to approach other problems in the rest of the work.

Computing enclosures of determinants of interval matrices is addressed. NP-hardness of both relative and absolute approximation is proved. New method based on solving square interval linear systems and Cramer's rule is designed. Various classes of matrices with polynomially computable bounds on determinant are characterized. Solving of interval linear systems is also used to compute the least squares linear and nonlinear interval regression. It is then applied to real medical pulmonary testing data producing several potentially clinically significant hypotheses. A part of the application is a description of the new breath detection algorithm. Regarding nonlinear systems an approach to linearizing a constraint satisfaction on an interval box problem into a system of real inequalities is shown. Such an approach is a generalization of the previous work by Araya, Trombettoni and Neveu. The features of this approach are discussed.

At the end computational complexity of selected interval problems is addressed and their feasible subclasses are captured. The interval toolbox LIME for Octave and its interval package, which implements most of the tested methods, is introduced.