Structural-parametric synthesis of mechanisms in CAD-systems

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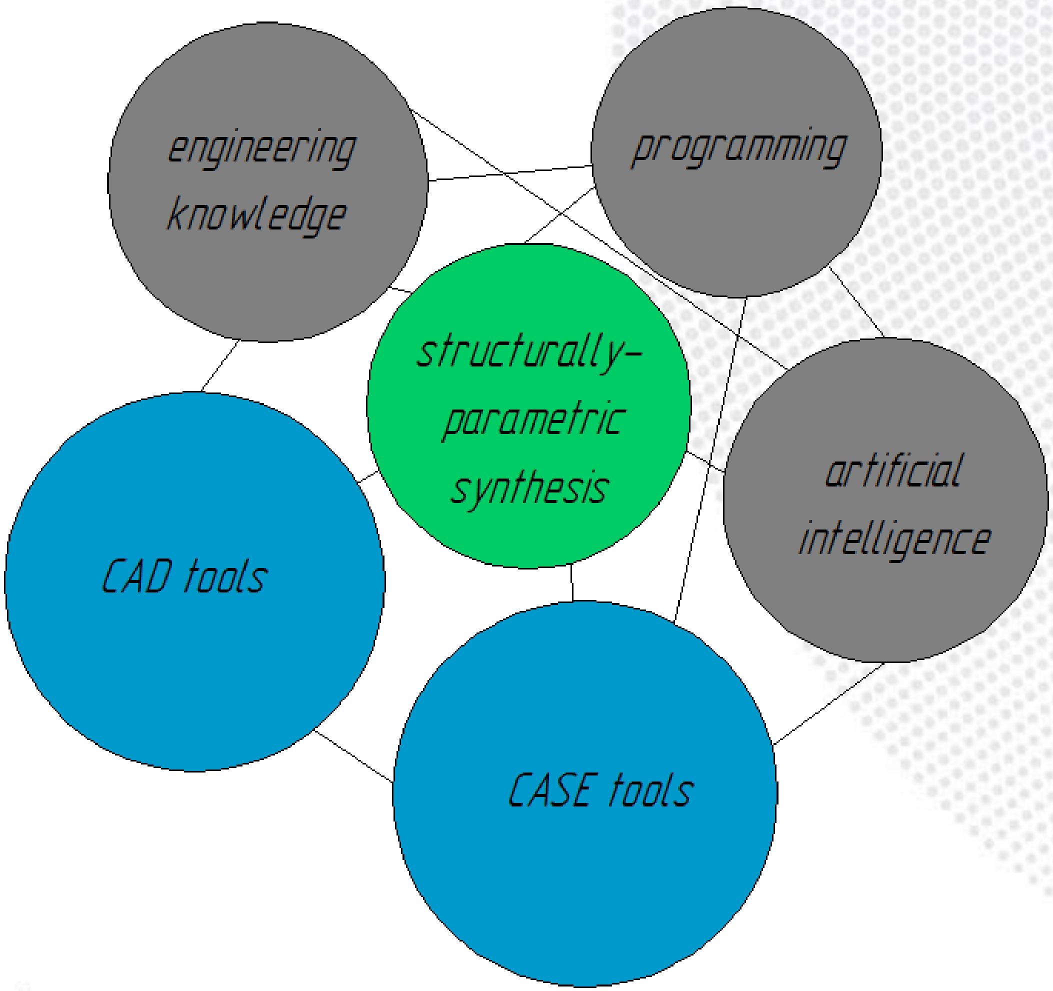
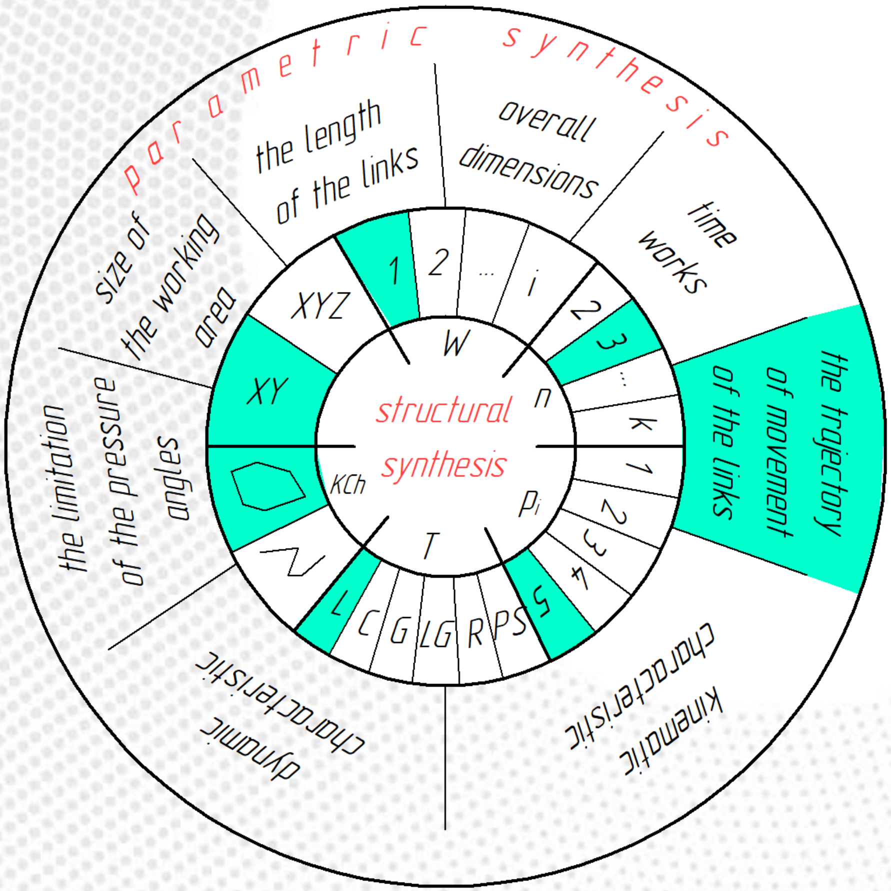
Problem statement, initial data and tools



The development of automatic design systems (CAD programs) entails a transition from parametric synthesis to structurally parametric, i.e. to designing a mechanism according to given parameters, taking into account given structural features. The main difference between structural and parametric synthesis is the determination of the structure during the synthesis process, as well as the possibility of changing it at various stages of design, in order to obtain a system with parameters that meet the requirements of the customer to the highest degree.

Structural-parametric synthesis of mechanisms can be represented as a diagram. Structural synthesis takes into account the number of degrees of mobility of the mechanism, the number of movable links, the types of kinematic pairs, the type of mechanism (*L*-linkage, *C* - cam, *G*- geared, *LG* - geared-linkage, *R* - robotic, *PL* – parallel-kinematic, etc.), and also takes into account freedom of the space in which the mechanism functions.



The operation of the mechanism depends, first of all, on the number of degrees of freedom, which determines the number of variations in the ratio of the number of links and kinematic pairs without passive joints and unnecessary mobility. In general, the formula for determining the number of kinematic pairs can be represented as:

$$(6-m)n-W=\sum_{i=1}^{i=5-m}(6-m-i)\,p_{(6-i)}$$

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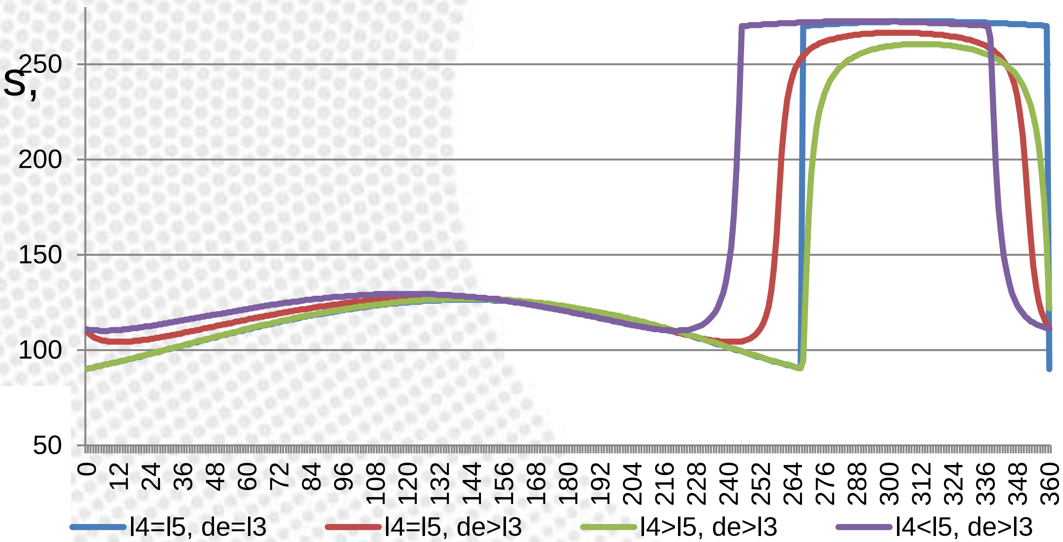
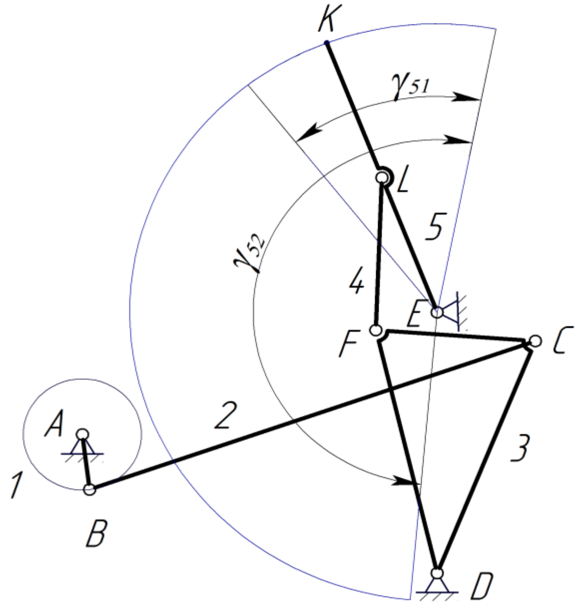
Visual and parametric synthesis in CAD systems

When designing link mechanisms, the use of CAD tools to solve synthesis problems greatly simplifies the task of finding optimal solutions.





The ability to visualize the result of the synthesis using animation allows one to see the synthesized mechanism in operation and adjust the necessary sizes. This technique is useful when the structure of the mechanism is initially unknown, but there are, for example, restrictions on the trajectory of the output link.

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Conclusion

The following results were obtained:

computer-aided parametric design systems can serve as a tool for solving the problems of structurally parametric synthesis of machine mechanisms;

the proposed structural-parametric synthesis algorithm determines the procedure for determining the parameters of the mechanism during the synthesis;

study of the characteristics of multi-link mechanisms with a given structure and a different number of degrees of mobility with CAD design tools allows one to determine which of the parameters of the mechanism affects the synthesis result in the most way, which makes it possible to maximize the synthesis output parameters to those set by the customer.

The creation of new mechanisms and the development of structural-parametric synthesis techniques using modern technologies is an urgent task of modern engineering. Using CAD tools and other automation tools enables to make the synthesis process effective and increase the efficiency of the mechanisms.