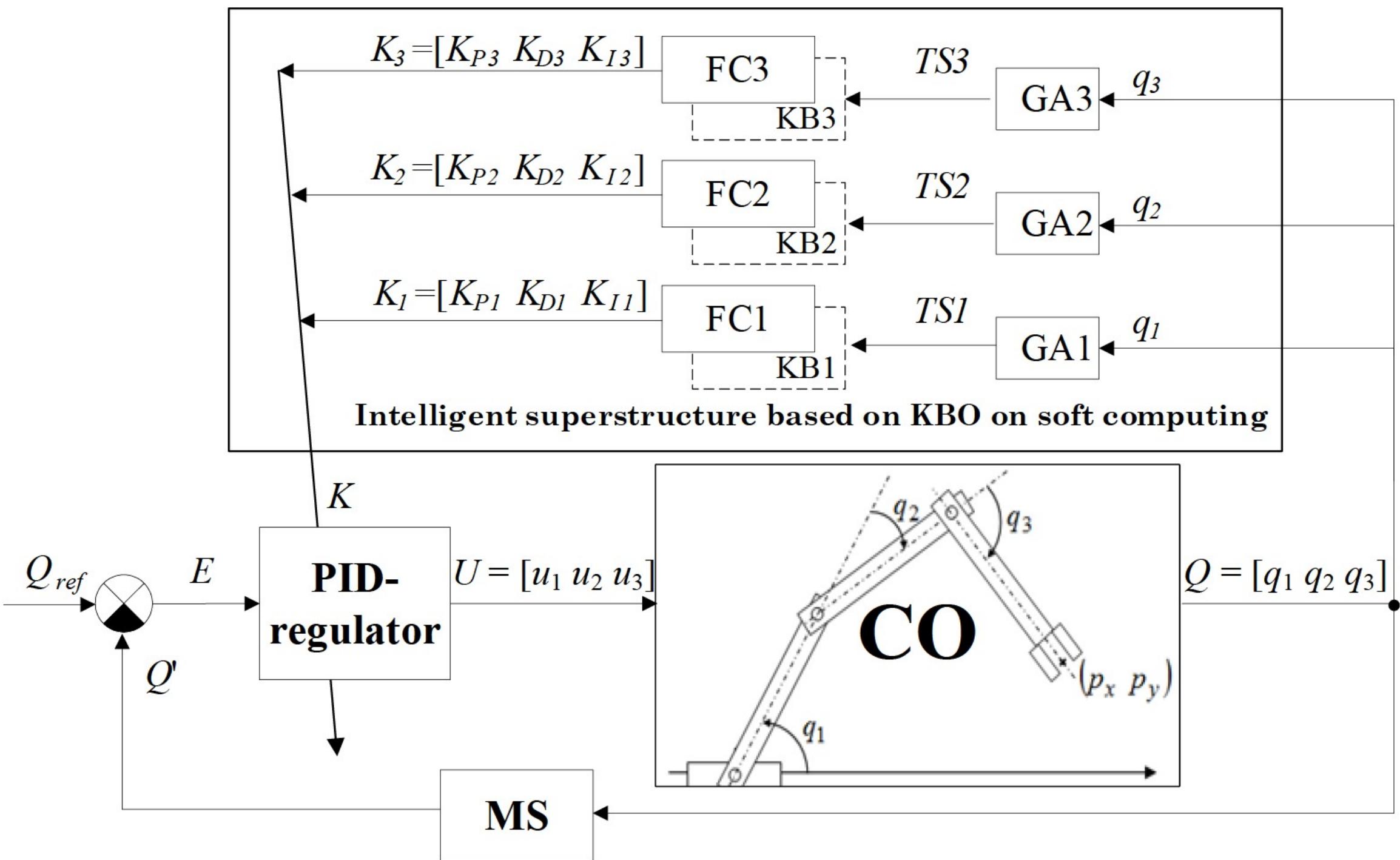
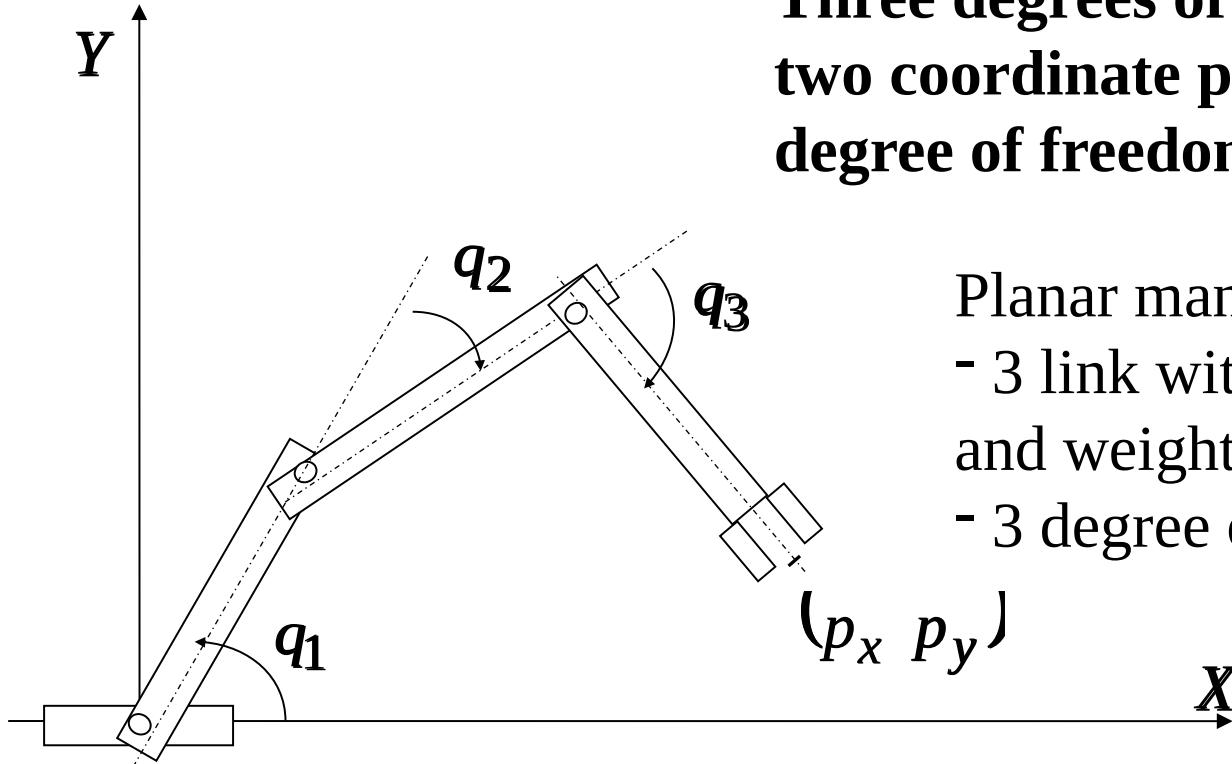


Intelligent Robust Control of Redundant Smart Robotic Arm: QCOptKB -Quantum Computing KB Optimizer Supremacy

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Katulin M.S.
MLIT, JINR**



The control task



**Three degrees of freedom MINUS
two coordinate plane = the surplus
degree of freedom**

Planar manipulator:

- 3 link with the same length and weight;
- 3 degree of freedom (3 DoF).

The task is to management of every individual position of the link

Mathematical model of N DoF robot-manipulator

Dynamic model of n -link manipulator:

$$\tau(t) = D(q)\ddot{q}(t) + C(q, \dot{q})\dot{q}(t) + G(q),$$

$q(t)$ a position vector of the links

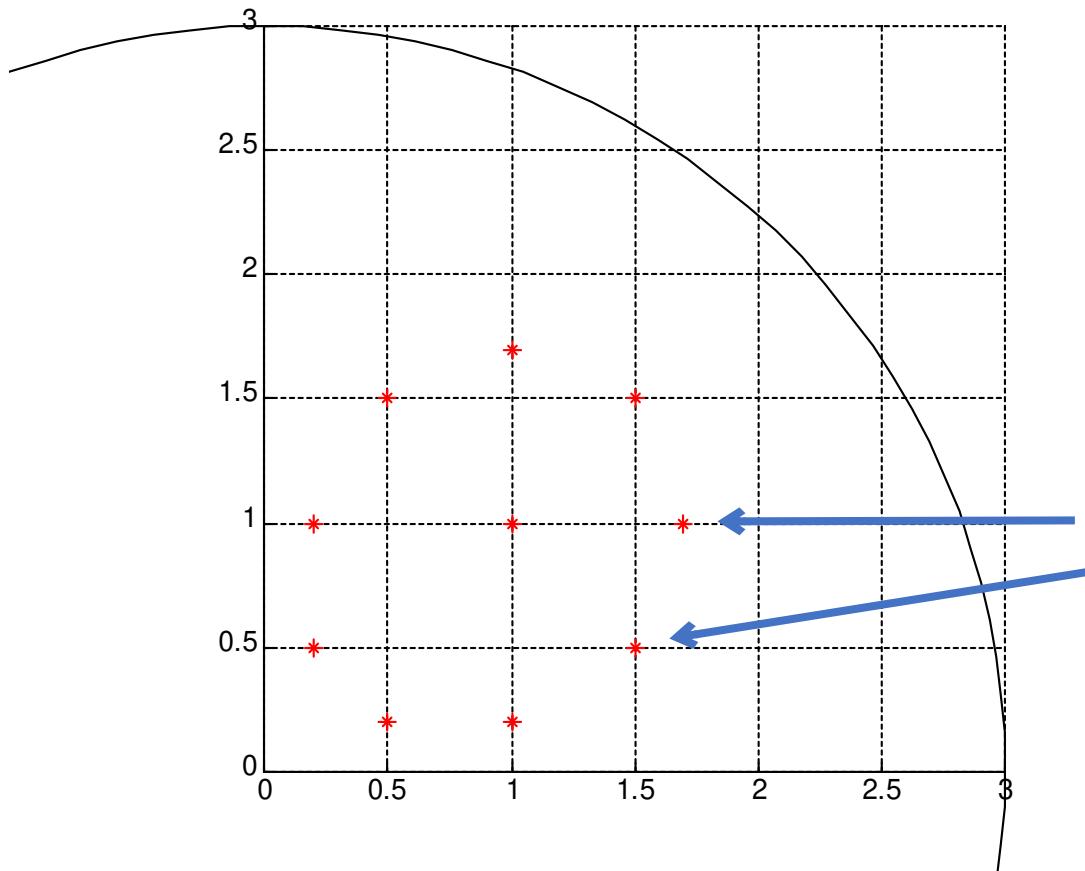
$\tau(t)$ a torque vector of the links

$D(q)$ an inertia matrix

$C(q, \dot{q})\dot{q}$ a centrifugal forces vector

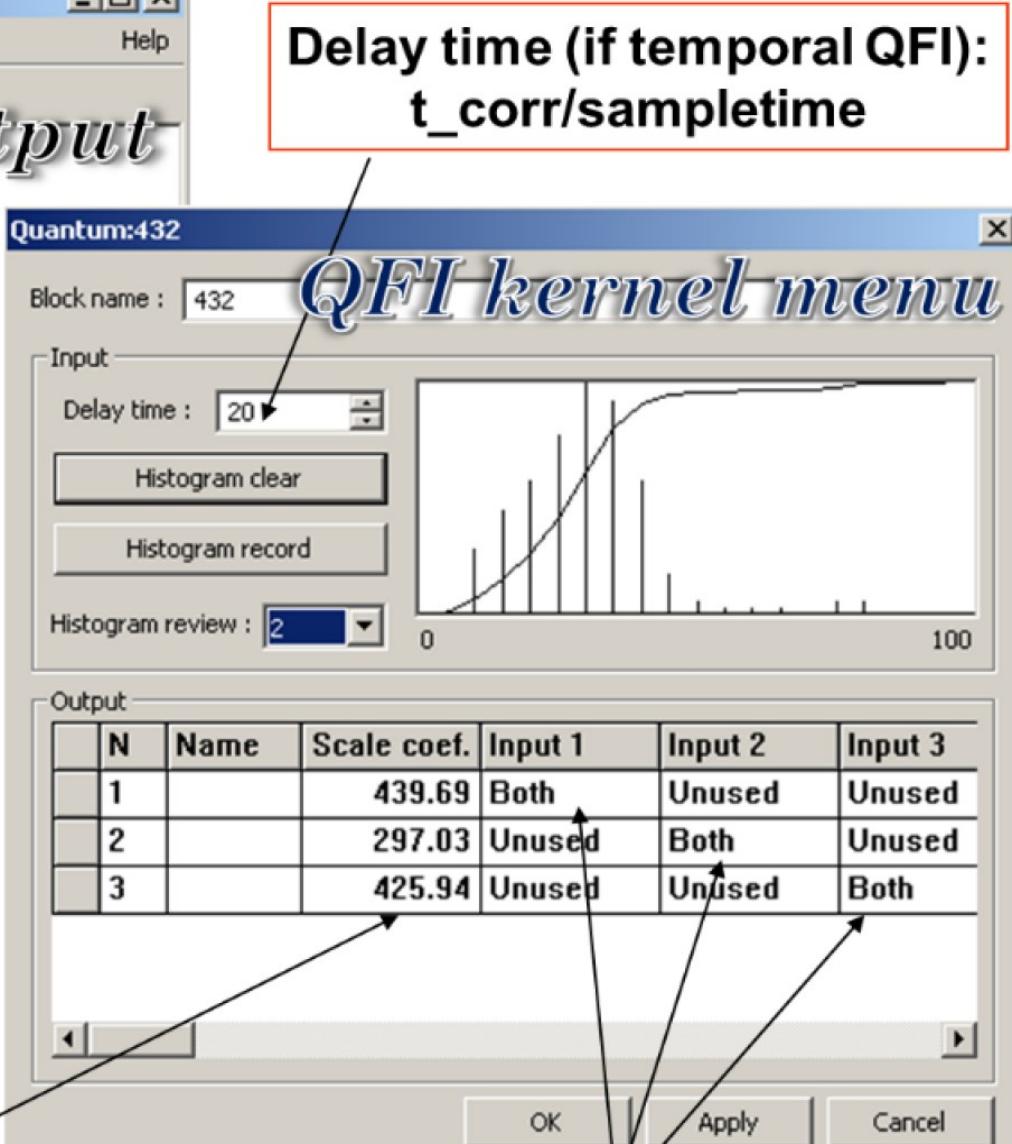
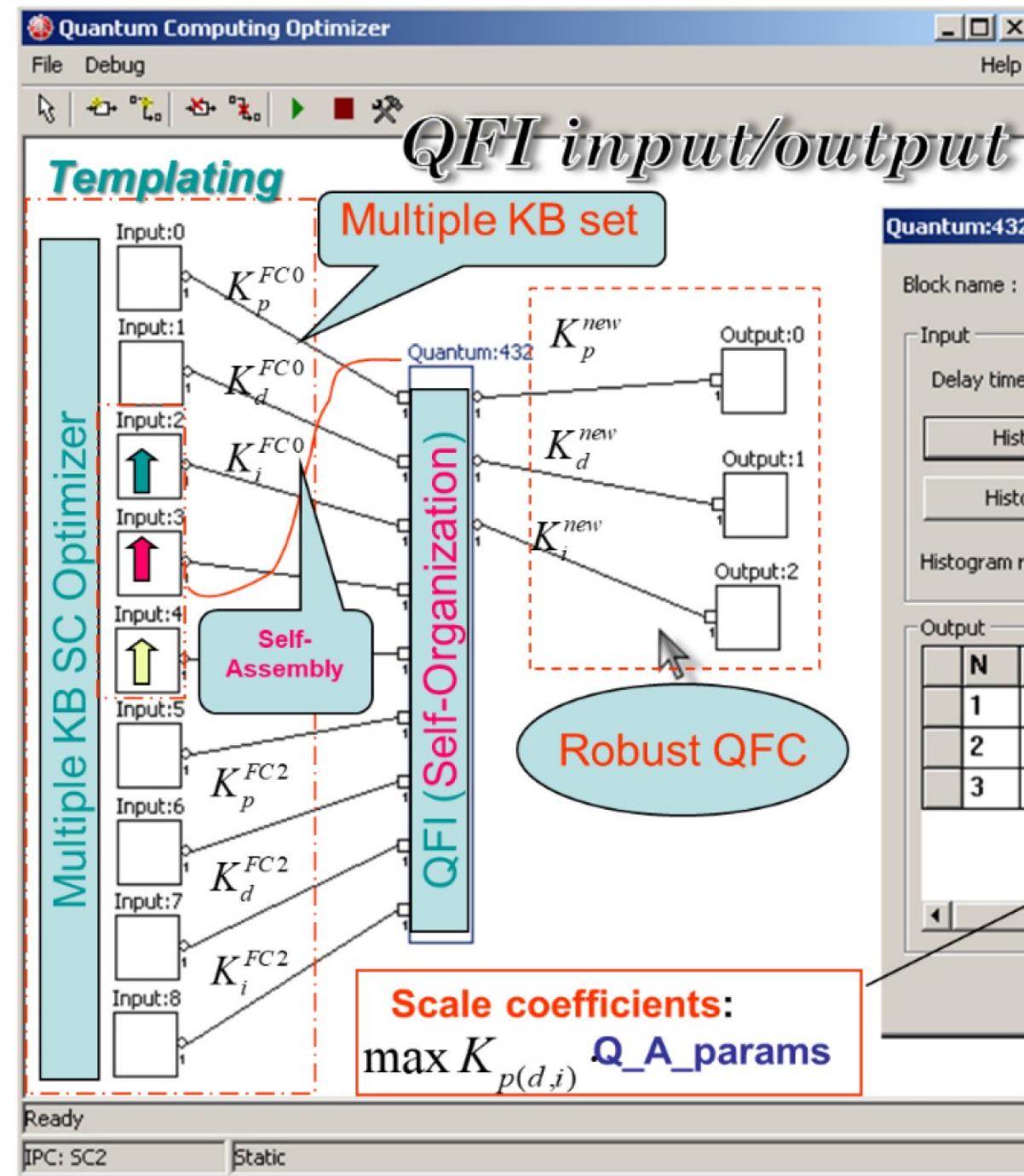
$G(q)$ a gravitational forces vector

The space for tests

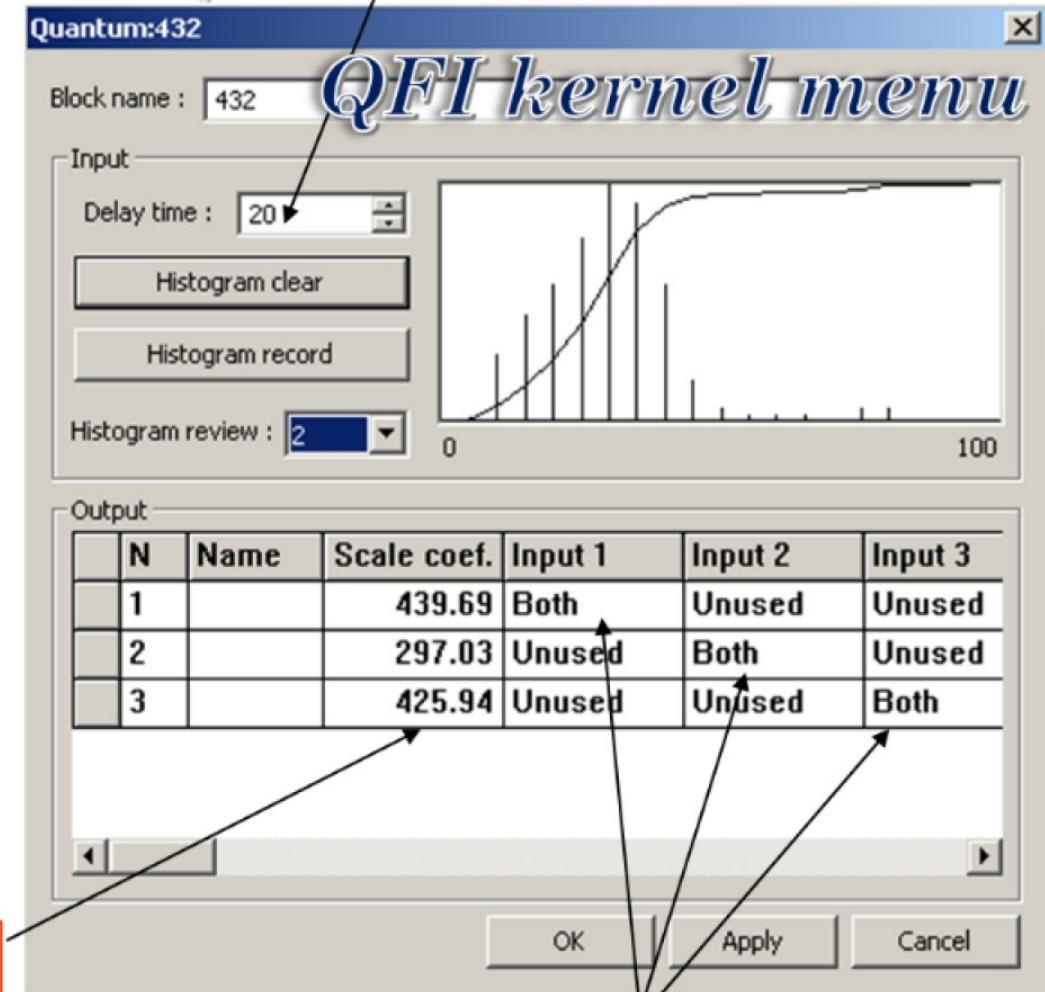
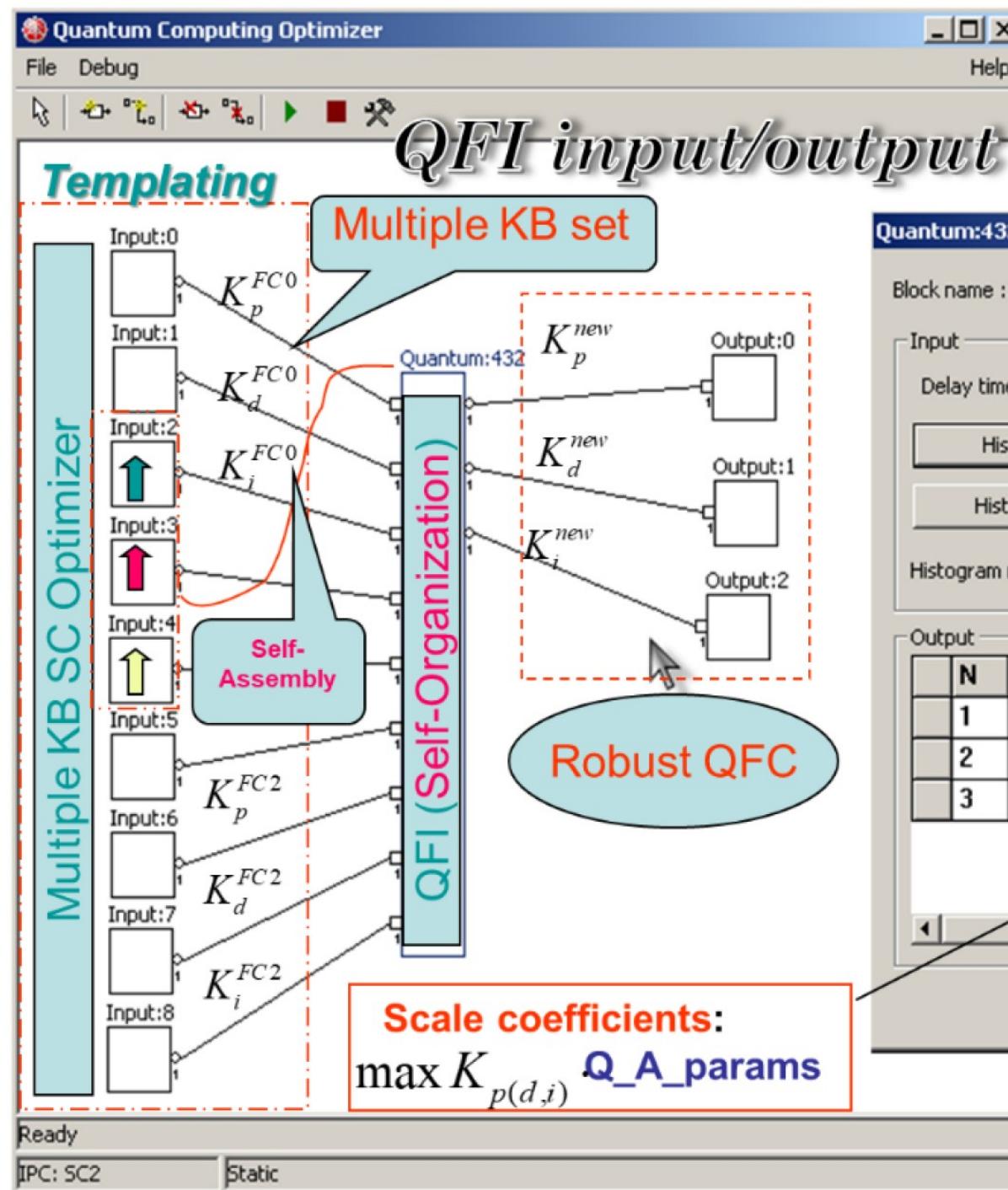


Restriction:
the distance from the origin
to the point can not be more
than sum of all links of the
manipulator

10 points for tests



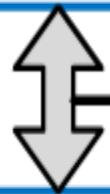
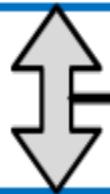
Description of correlation type



(a)

KB1 for link1

Standard control situation 1

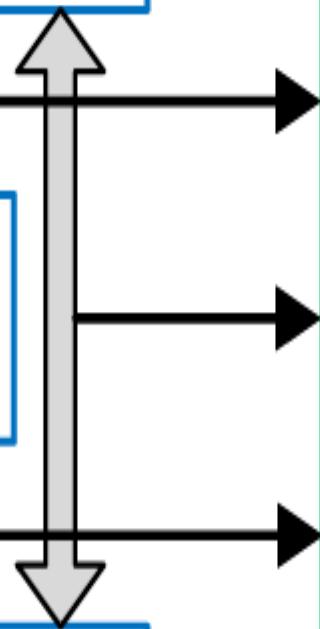


KB2 for link2

Standard control situation 2

KB3 for link3

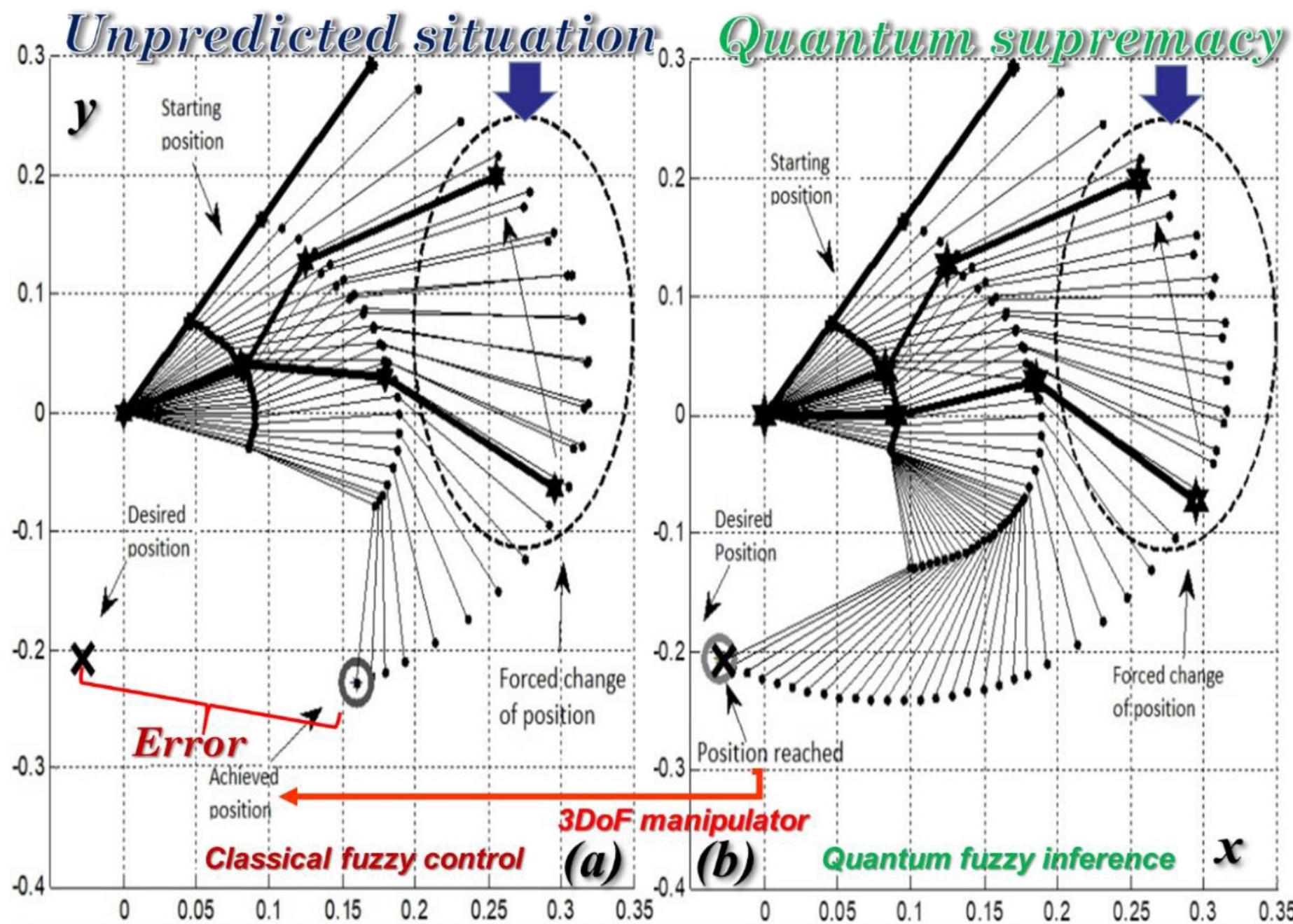
Standard control situation 3



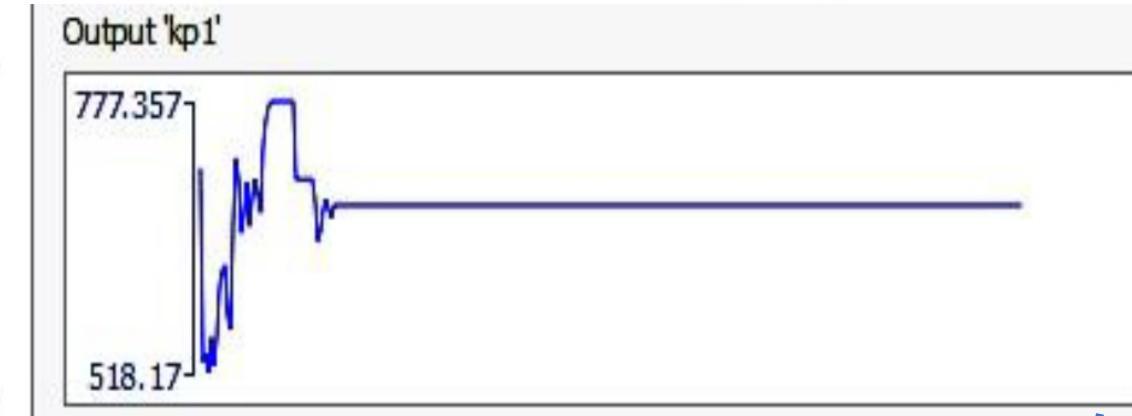
QFI



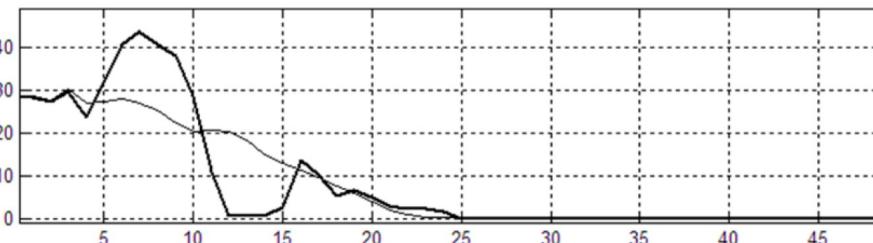
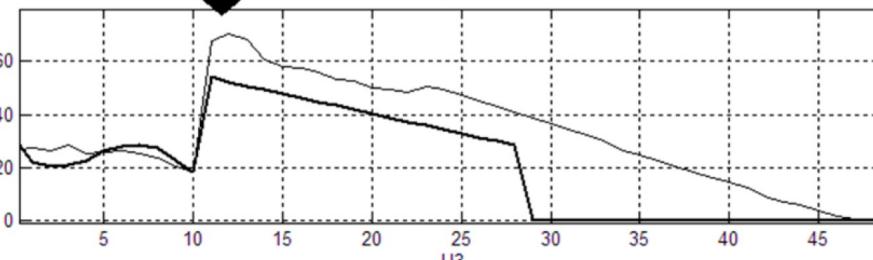
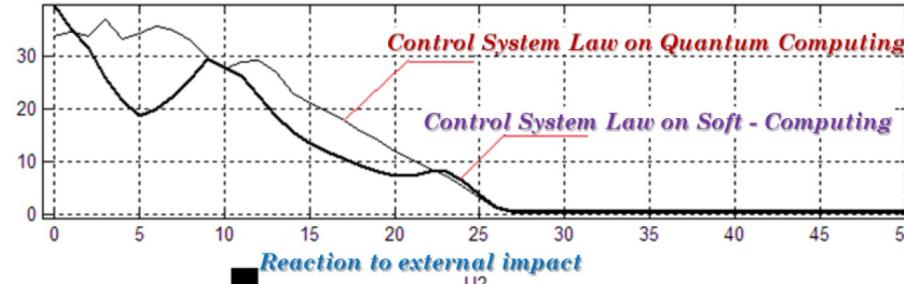
*Coordination control
of links 1-3 for:
Standard situations
1,2,..., N
Unexpected
situations
1,2,..., N*



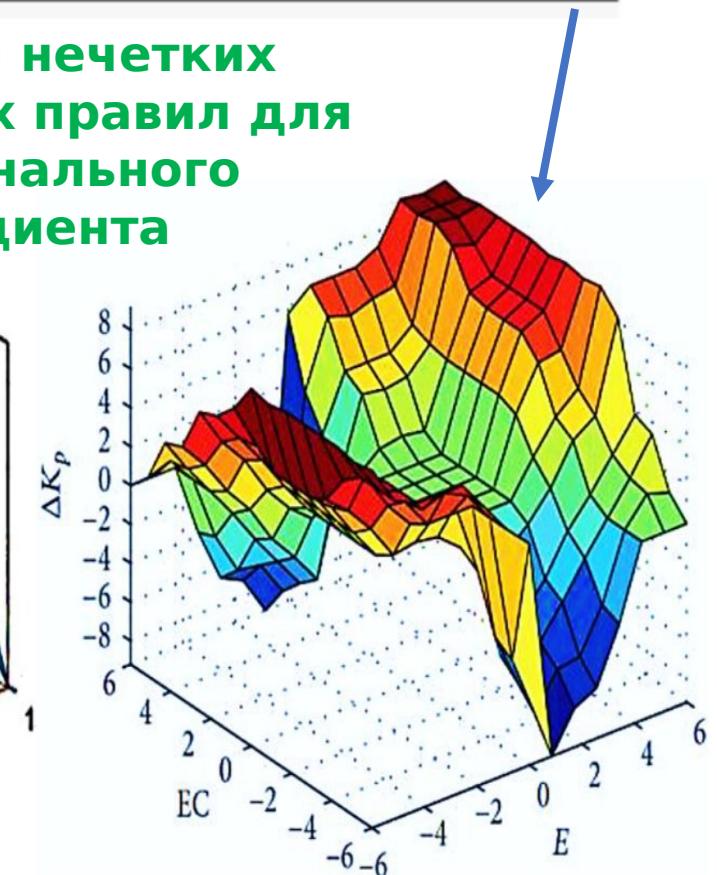
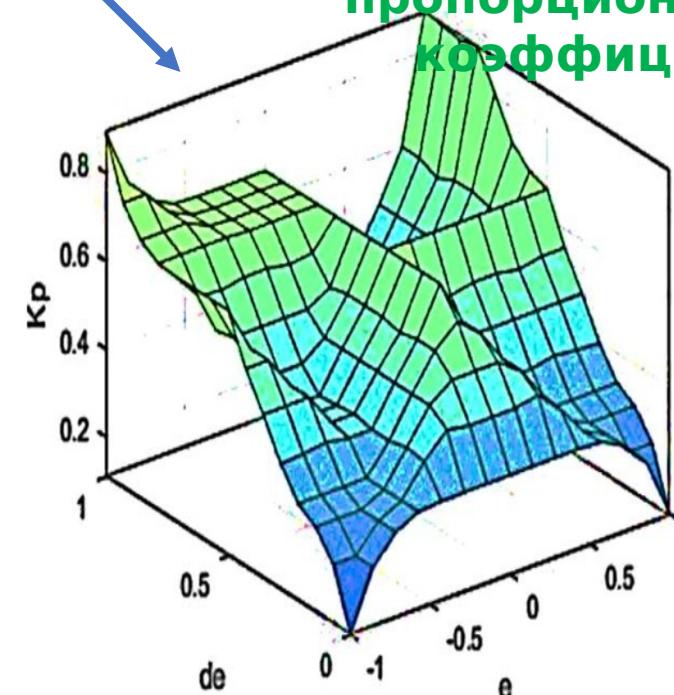
Коэффициент усиления пропорциональный до и после возмущения

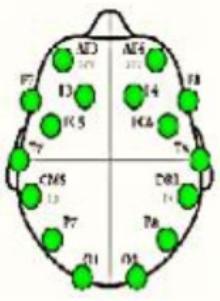


изменение законов управления на мягких
и квантовых вычислениях



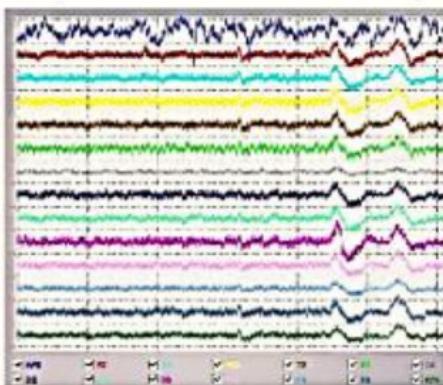
Поверхности нечетких
продукционных правил для
пропорционального
коэффициента





EEG

Operator brain activity



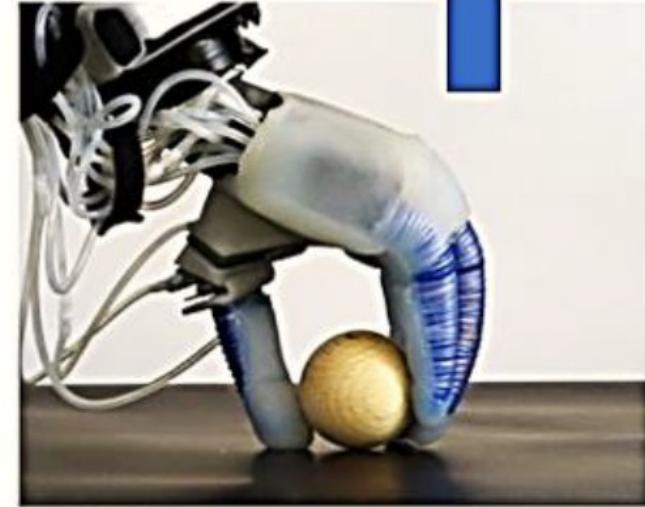
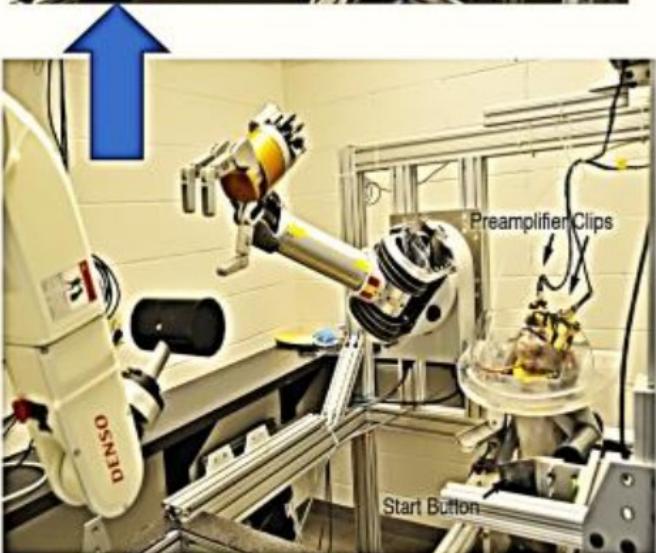
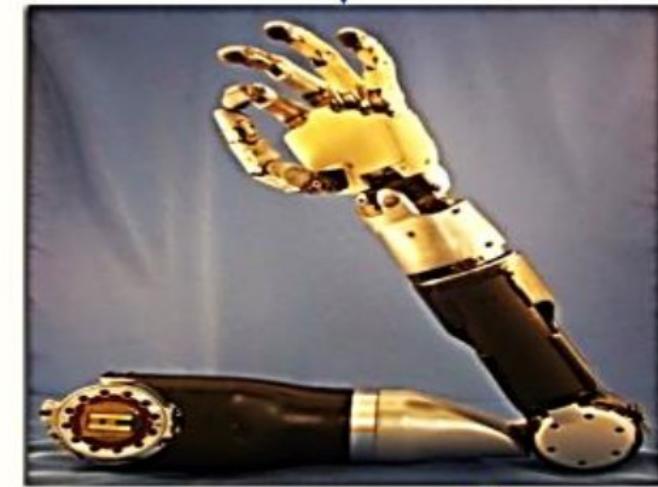
offline

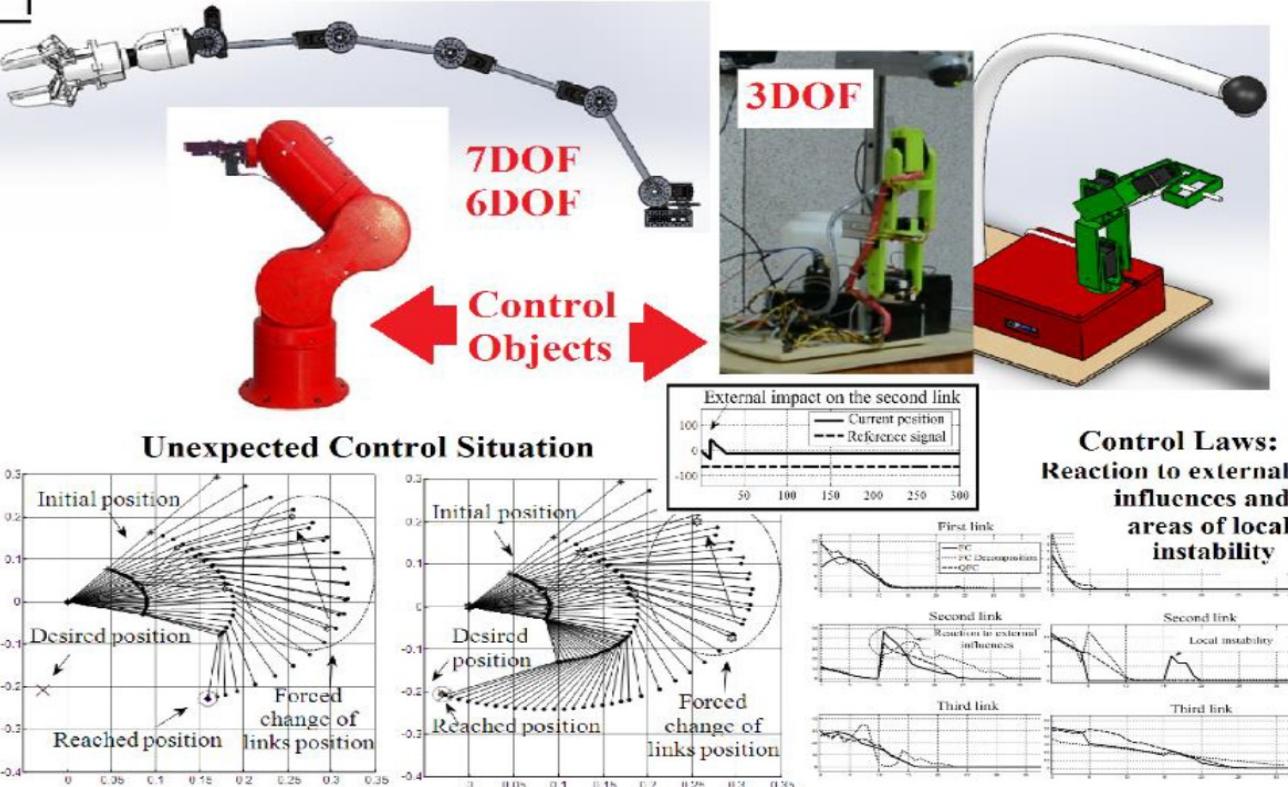
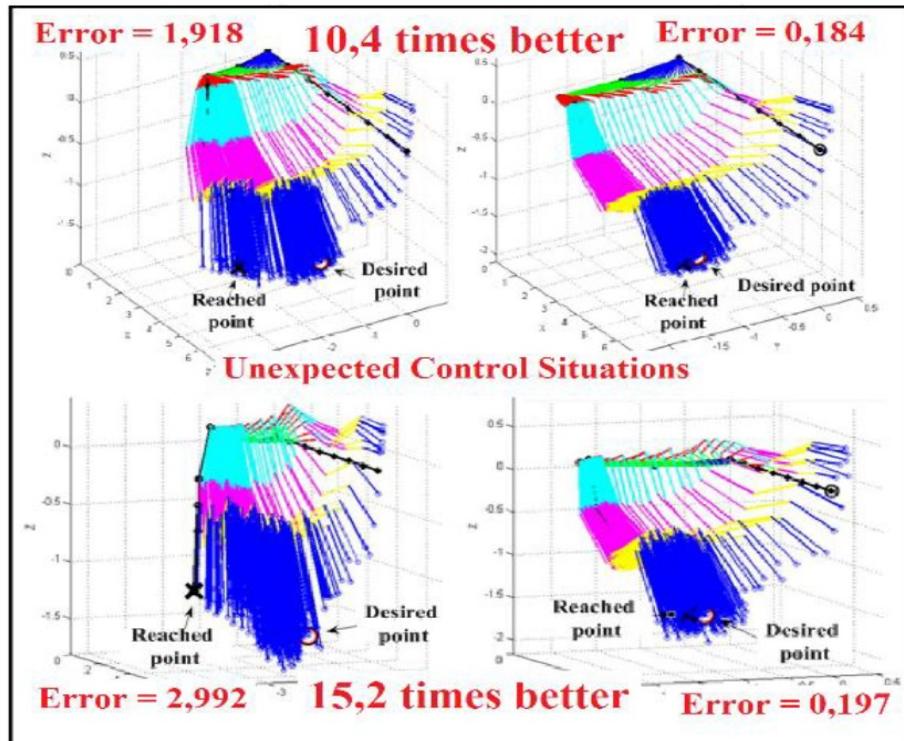
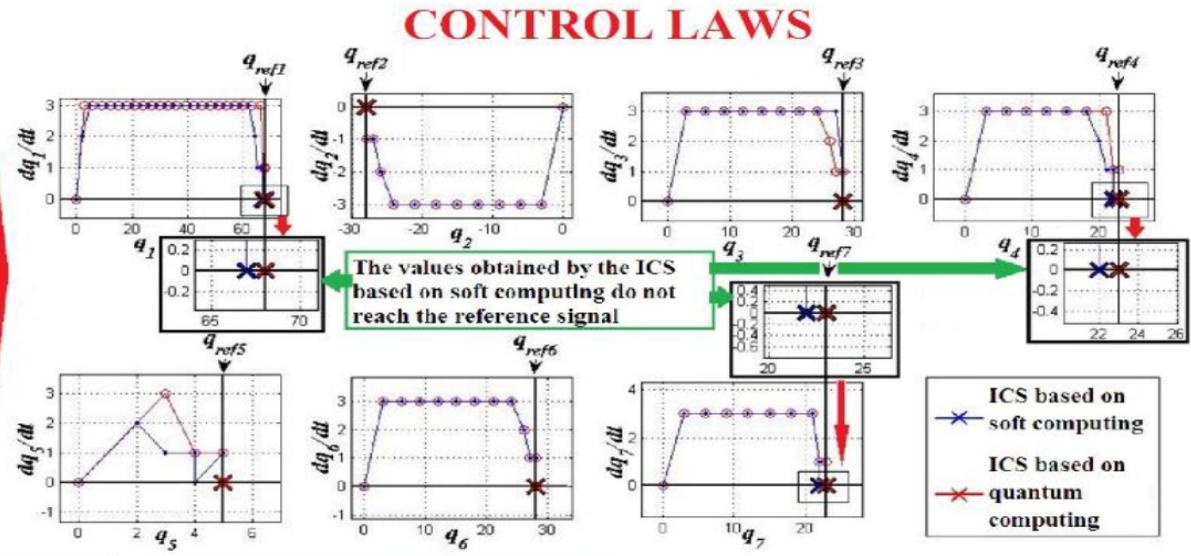
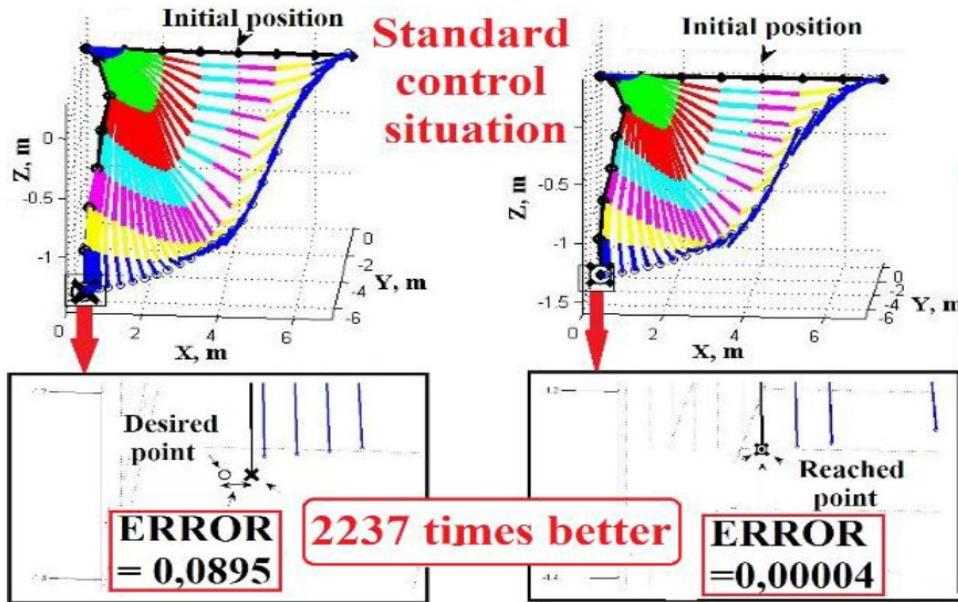


online

Intelligent cognitive control system

Control action





Conclusions

- This work presents the development of several high-tech areas of robotics, which have practical scientific and technical interest, both in separate and in joint developments.
- It has been shown that the prospect of developing cognitive intelligent control using soft and quantum computing technologies is one of the important tasks in creating a robotic prosthetic arm, such as a simple case of a robot avatar, and is integral to the development of information technology in the framework of an intelligent simulator concept [8]
- The use of expert recommendation systems with a deep representation of knowledge and quantum end-to-end technologies of deep machine learning with quantum EEG processing allows the appointment, selection of control of robotic prostheses of the hand, taking into account the individual psychophysiological characteristics of the patient and the operating environment.
- On the one hand, these are end products that, if properly developed, can be presented on the market of commercially attractive products; on the other hand, technologies for using new types of intelligent information technologies and human-machine cognitive interfaces.
- The next stage of development is the creation of a cognitive intellectual control system for a robotic arm-prosthesis for maintenance based on IT quantum soft computing, quantum EEG processing filters and Kansei / Affective Engineering intelligent computing technologies with an assessment of the user's emotional state.
- The work, in its essence, reflects the completeness of the formation of a new educational approach in intelligent robotics - a hybrid cognitive intelligent robotics based on neural interfaces with new types of IT data processing.