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Applying the modutarity principle in design of drive systems in mechanotherapeutic devices

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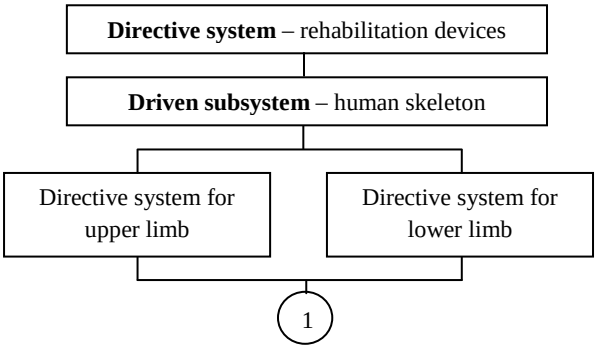
Abstrakt One of the basis sections of biomedical engineering is the rehabilitation engineering. The basis of rehabilitation engineering is the design and construction of facilities to help handicapped in different stages of the rehabilitation process. A necessary and essential part when designing rehabilitation devices is drive system.

Klíčová slova Mechanotherapeutical devices, drive systems.

1. DIRECTIVE SYSTEM OF REHABILITATION DEVICES

Interaction machines in medical rehabilitation process in terms of strength positioning, repeatability motion, safety and reliability depends on the compatibility of fuel systems. This is called. explicit application of drive modules that are elected - designed to real process while maintaining the dimensional requirements and technical parameterization, provided that part of the integration process and the devices will be patient - client.
Directive (Fig.1) and controlled subsystems (system) are together form an organic unity. Each of them has its own function and to one another subserve specific tasks. The concept of the control system is genetically relating to the technical sphere. Directive and controlled parts in it physically and spatially differentiated clearly. Based on the foregoing, the direct system which is in our case the rehabilitation devices has separate specifications, the requirements arising from the anthropometric, biomechanical and medical aspects, security aspects of human - computer interaction (programmable mechanical).



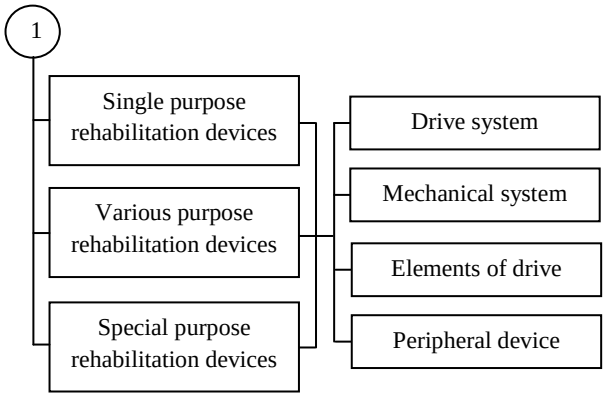


Fig. 1 Directive system - block diagram [8]

2. ANALYSIS OF SPECIAL REHABILITATION DEVICES

The term special rehabilitation equipment means a device intended for the client - patient, with various anomalies. In specific cases where are the patient's physiological parameterization is theoretically possible to use a single machine. Where a situation that skeleton man is not physiological, then it is necessary to adapt the kinematics and kinesiology in region such as:

- the end function,
- objective function,
- architectural level.

In the design of special devices rehabilitation is an essential part of modularity. Modularity system is an economical solution individual concept. This again provides a number of advantages such as a simple and expandable option to change equipment as required.
Possible areas of modularity are:

a) mechanics (new configuration)
   - joint,
   - arm,
   - frame,
b) directive
   - drive system (drive and attachment mechanism).

The objective of machine support physical rehabilitation is to measure and evaluate the physical condition rehabilitants for objective diagnosis and selection of appropriate therapies and controlled manipulation with treated motion segment for increasing physical abilities rehabilitants. Ancillary equipment used to drive the system to load increases, compliance constant speed and positioning of the patient. And just drives system is a key element in the use of modularity in special rehabilitation machines. The drive system is decomposition specified in the scheme in Fig. 2.
The structural arrangement of the drive system is seen as constructed in the above-mentioned hierarchical level, where they are applied and anticipation hypotheses expressions designing drive systems such as:

- typing machines,
- impact and benefits of structural families of machines and drive systems,
- impact and benefits and necessity of the application of the principle of miniaturization,
- unification of mechanical and control modules,
- modularity in creating a kinematic structures in the considered types of classification machine.

The above decomposition shows that the rapid and efficient selection of elements, nodes, modules and components can apply modern IT systems technologies. In this horizontal - vertical custody in the system requirements and tenders declared finished components which generate power modules required to drive the system.

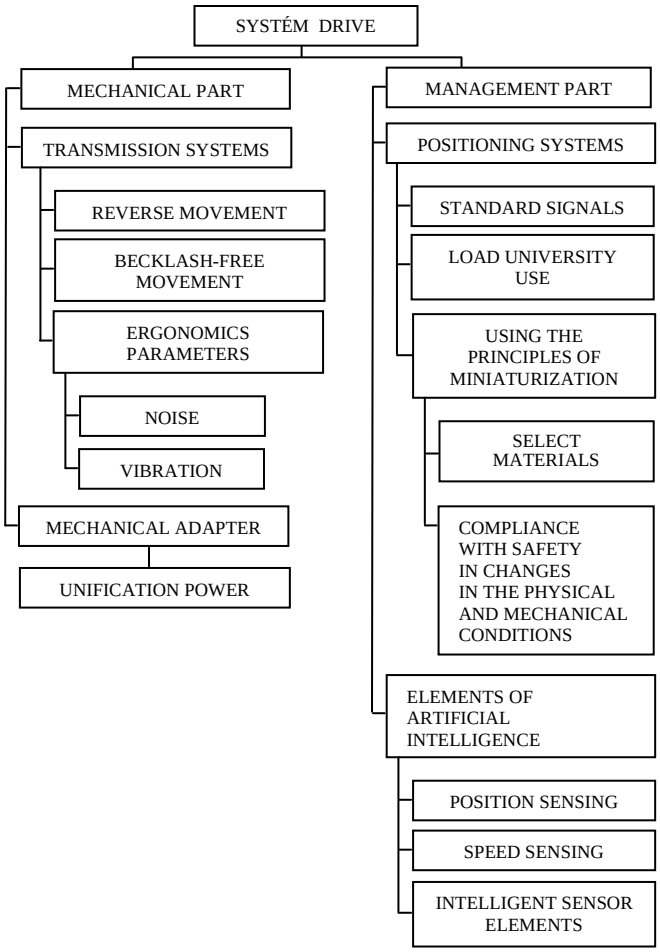


Fig. 2 Drive system - block diagram of hierarchical ties for therapeutic tools

3. MODEL SITUATION FOR THE SELECTION ELEMENTS OF DRIVE SYSTEMS

As already mentioned, an important component of your drive systems are geared systems. Prospective application of highly accurate transfers in health care, it can be examined by the need to adapt to our own design, size and the minimum weight transfer. It is anticipated construction materials of low density, high stiffness, reliability, positioning, control, and small size.
Harmonic gear recently found application in health care. Compared with ordinary gear drives are smaller and lighter, having a high kinematic precision, have little backlash, higher damping capacity, low weight, small space for large gear ratio and not least the high life. The disadvantage is difficult and expensive to manufacture, elastic deformation of the wheel due to torsional oscillations.

4. USE OF HARMONIC GEARBOX ON THE HEALTH SERVICE

Council PMG - consists of components Council HDUC, Gearbox, output shaft and creates a unit with large compact dimensions. This series provides high precision and compact dimensions. PMG is the advantage of high precision torque, high positional accuracy and repeatability, high torsional stiffness, zero backlash, high efficiency (Fig. 3).
Board CSF-Mini - the mini transmissions are restricted due to component board HFUC, with higher accuracy, higher-transferable torque and higher torsional stiffness (Fig. 4).

Fig. 3 Gearbox PMG

The benefits of Board CSF-Mini are transfer without backlash with high torque transmission, with increased speeds and cut-off corresponds to the torsional rigidity and accuracy, square bearing solid output with the output shaft or flange, various options for input and output elements and very low weight. Further possibilities harmonic gear is in the motors.

Fig. 4 Gearbox CSF Mini

The combination of CSF and DC gear motor generate RSF supermini series, which is characterized mainly extremely compact design and very light weight (Fig. 5).

Fig. 5 Gearbox PMA DC-Mini

PMA-Rad DC Mini is made up of a harmonious transmission of small or very small sizes (mini / supermini) in combination with AC servomotor and facilities for feedback (Fig. 6).

Fig. 6 Gearbox RSF Supermini

Gear wheels became a symbol of engineering. They are the basic element, through which transmission and transformation of mechanical power and movement are implemented in machines [3]. They are one of the most complicated mechanical components from the theoretical, construction and production viewpoint. The machines and machineries with gear transmission are very popular and draw sufficient attention. The weight reduction of the construction machines and engine plants as well as increasing of their efficiency and productivity, are all part of the important task in the area of the construction, technology and research workers must accomplish them [4].

5. CONCLUSION

The presented decomposition therapeutic plant and the subsequent design of the drive system based on the requirements to meet the target and the objective function, in to ensure the quality of the therapeutic process with the comfort of using modern methods of construction and IT technology.
The work presents and discusses the application of tool selection offered partial elements of those may be generated by the system.

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