Editorial

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Systematics of biomechanics

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Biomechanics was present already in the ancient Greek works, e.g. of Aristotle's monograph *Animal Movement*, Archimedes' works on draught and levers, Galen's works on human anatomy. In the Renaissance two important figures were developing biomechanics. Da Vinci provided note-book where he made drawings of the human and animal bodies. He specialized in anatomy and mechanics of the body.[1] Borelli[2] wrote *De Motu Animalium* where he described animal and human mechanics. Further important development of biomechanics was at the end of 19th c. (Muybridge from USA, Marey from France, Braune and Fischer from Germany) and the first half of the 20th c. (Bernstein from Russia), but especially during the second half of that century (Komi from Finland, Woo and Cavanagh from USA, Cappozzo from Italy, Morecki from Poland).

There were few areas of interest of previous biomechanists, namely body proportions (Vitruvius model), locomotion, muscle mechanics, equilibrium. Later on such areas as inertial problems, body systems (ventilation, circulatory, digestion), body posture, body control, micro-biomechanics, biomechanics of multi-bodies, biomechanics in bionics, computerization and robotization were developed. Several observation and experimental methods of research were also developed: mechanical, electro-mechanical, photo, radio, penetrating, modeling.[3]

Since biomechanics encompasses many scientific areas it is worthy to establish its systematics, i.e. presentation of areas in a regular order.

The introductory areas are: essence and definition of biomechanics, its aim, relation to other scientific disciplines, history, contemporary knowledge.

It is positive to obtain some knowledge on basic, introductory, and assisting sciences such as: biology, especially anatomy, physiology, science on plants (botany), science on animals (zoology), science on humans (anthropology), mathematics, metrology, mechanics, materials science and other.

Real biomechanics consists of fundamental (pure, basic) and applied biomechanics. Within fundamental biomechanics one can differentiate: morphology, function, and control of living objects. This is described as regular (normal) and pathological biomechanics. Within the regular there is natural (essential) and interaction biomechanics and influence of environment. This interaction takes into account several situations influencing the outcome, e.g.: carrying goods, physical and mental tiredness, influence of other living or artificial objects, influence of environment and other situations. Pathological biomechanics consists of: diagnosis, therapy (treatment), rehabilitation (especially physiotherapy), convalescence, prophylaxis.[4]

Within the systematics approach there is also science, including research methods, and dissemination of knowledge, including popularization and education. Figure 1 shows a scheme of biomechanical systematics.

Natural biomechanics of e.g. walking is applied when diagnosis of locomotion is performed. Here a subject walks straight, on a hard surface (e.g. wooden), without shoes, in a loose underwear. There is no spectators, enough of light, room temperature, silence, no hurry.

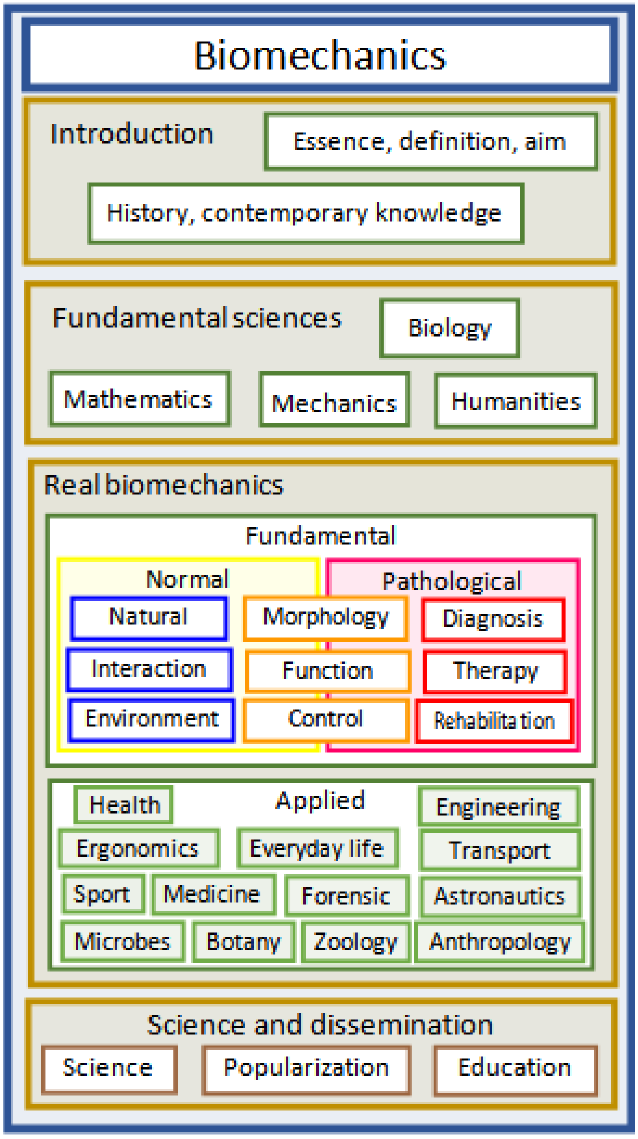
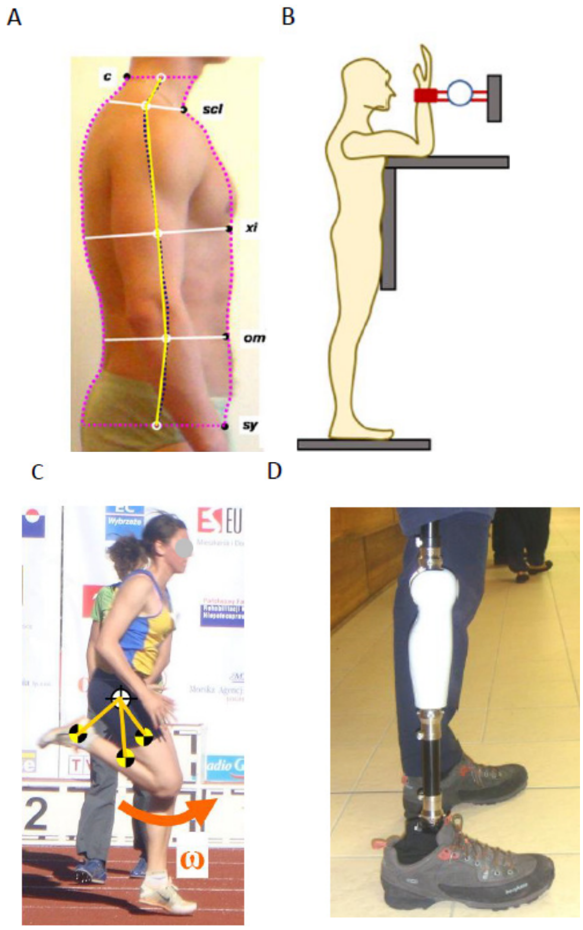


Figure 1 Scheme of systematics of biomechanics.

Within interaction approach to the real biomechanics one can describe walking as follows: a) in a faster way due to be in a hurry; b) while carrying heavy, hot, fragile, or expensive objects; c) of special aim, e.g. soldier parade or guard walking; d) on uneven surface; e) on slippery surface, e.g. snow, ice, oil; f) in oblique direction, e.g. up-hill or up-stairs; g) being in a pathological state wearing an orthosis or walking with crutches – Figure 2.

Figure 2 Interaction biomechanics: different types and hence different biomechanical techniques of walking: on a horizontal, flat surface while being in a hurry (A) and during special soldier's march (B), on snow surface on feet (C) and on skis during telemark walking (D), going up-hill in addition with a backpack (E) and up-stairs (F), using an orthosis and carrying goods (G) and using crutches (H).

Huge area of applications takes into account: implementation, exploitation, correction. The main applications are as follows: health, everyday life, ergonomics, engineering, transport, astronautics, sport, medicine, forensic, psychology, sociology, anthropology and other. Some examples of applied biomechanics are presented in Figure 3.



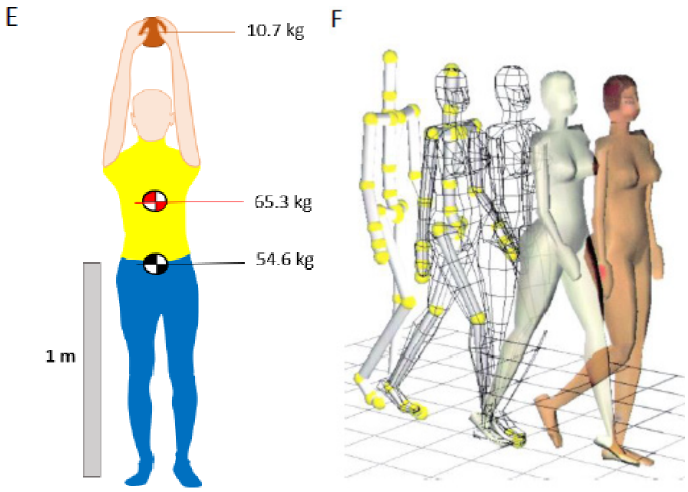


Figure 3 Examples of applied biomechanics: A – body posture assessment; B – typical configuration of a body during measuring resistance force of a dynamometer and its arm of action giving moment of force from which muscle force is calculated when muscle arm is known; C – angular momentum of a lower extremity (moment of inertia times angular velocity); D – biomechanics and biomedical engineering in the development of prosthesis; E – a scheme from forensic biomechanical report showing a 15-year old pupil who did not throw a log during an out-door class of handball specialization, he fell down and a log crushed his head; F – human model developed by Aschenbrenner from Gdansk.

References

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