Bio-Inspired Biomedical Engineering and Intelligent Wearable Systems

This issue of Big.D presents a particularly strong convergence of bio-inspired engineering, biomedical technologies, intelligent sensing, robotics, and wearable systems. The contributions demonstrate how biological structures, physiological mechanisms, advanced materials, and computational intelligence can inform the design of next-generation healthcare technologies.

Bio-inspired principles appear across multiple scales. Microfabricated adhesive structures translate biological adhesion mechanisms into atraumatic tissue manipulation, while soft robotic systems explore biomimetic approaches to targeted drug delivery and minimally invasive intervention. At the nanoscale, magnetically driven photosensitive robots combine controlled motion, imaging, and therapeutic functions for cancer treatment. These studies illustrate how biological inspiration can move beyond morphological imitation toward functional engineering strategies.

Human–machine integration represents another major direction. Research on continuous neural control of prosthetic hands and neuro-adaptive exoskeletons demonstrates the increasing integration of neural information, intelligent control, and biomechanical systems in rehabilitation engineering. Personalized biomechanical design combining 3D printing with neural-network modeling further connects computational methods with patient-specific manufacturing.

Wearable and flexible technologies constitute a third major theme. Intelligent electronic skin, smart insoles incorporating self-powered triboelectric sensing, design-driven sleep-intervention systems, and bio-inspired flexible sensors demonstrate how advanced materials and sensing architectures can support continuous monitoring and personalized intervention.

Together, these studies reveal an emerging engineering paradigm in which design, biology, materials, computation, fabrication, and clinical needs are integrated within complete technological systems.

This convergence closely reflects the mission of Big.D. Design-enabled engineering is most powerful when it translates interdisciplinary knowledge into measurable technological functions, validated devices, and implementable systems. The papers in this issue provide compelling examples of that transition within biomedical and wearable engineering.