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Movement Assisting Devices

MANUFACTURING OF PERSONALISED KINETO-DYNAMICS PARTS AND PRODUCTS FOR WORKERS, ELDERLY AND CHILDREN

Newsletter 5 – October 2018

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MOVAID CONSORTIUM

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True servitisation: A future reality

The beauty of the MovAiD framework is its holistic approach to integrate product and service provision. It considers the overall information and process flow. It is developing technologies to capture body shape and movement, undertaking musculoskeletal modelling to optimise forces acting inside and on the body of an individual wearing a Movement Assistive Device (MAD).

Through computer simulation, the framework can optimise how a MAD performs, design tools to define its shape, place the joint mechanisms correctly and automatically define the stiffness of the material it is made of. Then, the MAD design is sent to local and central additive manufacturing machines to create its actual design.

But the MovAiD framework does not stop there. It also provides monitoring and support post-fitting. Therefore, working towards the vision of a true servitisation.

MovAiD Coordinator Sir Saeed Zahedi

Get our latest news

Read about the presentation of the MovAiD paper at OT World, watch a recording of the AnyBody webinar and get an update on the final MovAiD workshops.

MovAiD paper presented at OT World

We presented a MovAiD paper regarding sensing technology at OT World in Leipzig in May 2018. OT world is a major trade show and congress. It enables inter-professional interchange between orthotists and prosthetists, orthopaedic shoe technicians, podiatrists and chiropodists, rehabilitation technicians, therapists and doctors, engineers and funding organisations.

The paper reported the latest findings on 'Plantar centre-of-pressure tracking in smart orthoses using a sparse array of optimally-distributed pressure sensors.' Smart sensing plays an important role in the overall MovAiD concept and the vision of servitisation.

Watch 'Simulations as a tool for human-centred exoskeleton design'

Hosted by Pavel Galibarov from AnyBody Technology, this webinar is presented by product specialist Ananth Gopalakrishnan. The webinar focuses on the value of simulations for exoskeleton design refinement and evaluation of exoskeleton benefits using computer models of human-exoskeleton interaction. The session finishes with a Q&A.

Watch more.

Update on final MovAiD workshops

Two final MovAiD workshops have taken place to disseminate the latest findings of the project. The sessions were well attended and took place at the International Central Europe ISPO Conference 2018 in Portorož, Slovenia from 20 to 22 September 2018 and the ISPO UK Annual Scientific Meeting in Southampton on 12 and 13 October 2018.

Many engaging discussions arose and covered many aspects of the project like:

- The timing and availability of the MovAiD framework,
- Its potential for innovation,
- How the future of service provision is different,
- What steps attendees can take now to prepare for the future,
- The responsibility of data-driven design,
- Data safety.

Update from Work Packages (WP)

Read the latest on each Work Package.

Understanding what the target groups need

Work Package 1 focuses on identifying target groups, understanding their needs and translating these in into technical requirements to design specific Movement Assistive Devices (MAD).

Each MAD is customised to the individual user and has the potential to reduce costs associated with treating movement disabilities and preventing injuries.

Work Package 1 analysed three target groups, including workers, the elderly and children with neuromuscular disease. The team identified typical target movement range, movement dynamics, potential sensor systems and preventative or corrective aspects and formulated this data into a reference design.

Versatile and dedicated sensors and the integration platform

Work Package 2 is designing a versatile and dedicated sensor network to be embedded in each Movement Assistive Device (MAD) supported by the integration platform.

The sensor output feeds into the automatic design tools. Sensors in the device collect data while it is being worn, assess parameters and provide feedback. Taking into consideration the information required, a sensor network design was created that includes inertial as well as interface pressure sensors. These help to understand the overall MAD performance and identify any need to replace spare parts.

Overall the sensors serve two purposes: data driven design and post-sales support and service. This is all supported by the underlying integration platform.

Advanced materials

Work Package 3 defined and developed the materials to address the innovative features of each Movement Assistive Device (MAD) that comes into contact with the body.

Based on biometric data they were able to create material that is functional and personalised. By using additive manufacturing technologies (such as 3D printing) they can actively control the variations of material to an individual scale and produce geometrically-complex parts and graded materials.

Functionally-graded materials were developed to act on two levels. On a micro scale, gradual variations of material were composed using fillers, addressed to parts that are produced through extrusion techniques. On a meso-macro scale, material distribution is achieved through complex geometries and lattice structures created with powder-based additive manufacturing.

An analysis of biomimetic strategies suggested diverse natural tactics in plants for addressing the fine control of mechanic and physic properties through cellular materials and composition variations.

A series of experiments to test the cell geometry and the relative density of plants were undertaken to advise on additive manufactured samples. The tests unveiled a large extension of properties.

The data, functions and rules have been tested and used for feeding a proprietary computational design software, which can fine control the design of functionally graded materials.

Building the interface between sensor data, MSM simulation and MAD design

Work Package 4 focused on the interface between sensor data, musculoskeletal modelling (MSM) simulation and translating findings of the MSM into the actual Movement Assistive Design (MAD).

A knee-ankle-foot orthosis (KAFO) is being specifically designed for the elderly. Using MSM simulations, the Work Package 4 team is working on developing the assistive gait functionality of the device as well as considering the ability to stand and bend the knee using the KAFO. An automated simulation design pipeline has been created.

Data captured from the upper extremity of the body is integrated into the MSM simulation model to better target devices for workers' needs. Assessment of ergonomics has been undertaken for targeted activities.

Based on the MSM data, a customised, data-driven design is created for each user based on individual scan and motion data. Human surface interaction modelling helps to estimate body contact forces in a grid on the conceptual MAD model, and move from modelling and simulation to generating design.

These and including device dimensions that fit the user, are exported and sent to subsequent processes targeting the design of each MAD component.

Additive manufacturing machine for producing structural and body fitting parts

Work package 5 concluded the engineering activities of the centralised and local additive manufacturing solutions to produce Movement Assistive Devices (MAD).

At manufacturing level thanks to a new and continuous Selective Laser Sintering process the team has created a carousel to manufacture, in parallel, different structural parts of each device belonging to different users.

At orthopaedic workshop level, a novel AM machine for freeform deposition of multi-material body-fitting parts has been developed. It handles concurrently rigid, elastic and conductive material, so the MAD can perform differently depending on how it is placed on various parts of the body.

These centralised and local additive manufacturing solutions are engineered so devices can be assembled and detached quickly. They build a final MAD product endowed with custom-made features and with conductive tracks to transfer power and signal information from sensors to an onboard elaboration unit.

Information derived from this elaboration unit feed a continuous monitoring and service-based approach. This can result in manufacture of new parts from the aforementioned machines, and follow-up on the user's conditions and activities.

Project outlook

The power of the MovAiD framework lies in the system integration of many different emerging technologies such as scanning, sensing, advanced modelling, computer-driven design and additive manufacturing. By combining the elements in a meaningful way, the project creates added value.

It will be fascinating to see how the future of customised Movement Assistive Devices will look like. There is a huge potential in using the various technologies to tackle recent societal challenges, such as demographic change, disability, loss of mobility with age, pressure to increase worker productivity and shortage of qualified people. MovAiD provides a glance into the future.

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Questions? Contact us

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