OActive NEWSLETTER

Advanced Personalised, Multi-Scale Computer Models Preventing Osteoarthritis

Issue 4: December 2020

Table of Contents

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Grant Agreement No. 777159.

Join us at:

OActiveProject

OActive

1. Partner Interviews

ASK AN EXPERT!

EFTHYMIOS STATHAKIS,
DATABASE DEVELOPER AND DATA SCIENTIST, CETRI, CYPRUS

1) What would be the benefits for the public from your research/ involvement in the project?

The main benefits for the public: a) Boosting the research in the field of OA using AI/ML methods, b) creating a big data pool with OA related clinical data, c) develop a flexible environment for OA research.

2) What could be the benefits/take-home messages for all partners involved in such an initiative?

a) Learn to work with interdisciplinary research groups, b) gain know-how in new scientific fields and c) learn and adjust their toolbox and methods in problems with different requirements.

MAHAULT PIÉCHAUD BOURA,
LAWYER, TIMELEX, BELGIUM

1) What would be the benefits for the public from your research/ involvement in the project?

Supporting compliance with the data protection requirement of the OActive solution.

2) What could be the benefits/take-home messages for all partners involved in such an initiative?

Data protection is to be minded at every step, it is as much a legal as an ethical requirement.

DIMITRIOS TSAOPOULOS,
RESEARCHER, CERTH, GREECE

1) What would be the benefits for the public from your research/ involvement in the project?

The development of computer-based, patient-specific predictive models of the occurrence and progression of OA forms the main objective of the OACTIVE project. This valuable medical tool could be used in preventive medicine, to predict occurrence or worsening of the OA disease in people at risk.

2) What could be the benefits/take-home messages for all partners involved in such an initiative?

OActive partners can benefit from the project through exchanging of ideas, experience and know-how for new projects.

GEORGIOS GIARMATZIS,
SPORTS SCIENTIST/BIOMECHANIST, RESEARCH ASSISTANT, UNIVERSITY OF PATRAS, GREECE

1) What would be the benefits for the public from your research/ involvement in the project?

The development of a high-end AR platform, functioning upon a powerful musculoskeletal simulation engine, will enable both scientists and medical experts to explore human motion and its effect on knee joint loading. At the same time, patients will benefit from the real time biofeedback received through a seamless gaming

OActive

1. Partner Interviews

interface, towards an improved motion strategy to alleviate the adverse effects of knee osteoarthritis.

2) What could be the benefits/take-home messages for all partners involved in such an initiative?

Osmosis between different research fields, taking place in the OActive project, will augment understanding of progression of knee OA and the interplay between psychosocial, biological, and mechanical factors of the disease. Collaboration between OActive partners will promote their research capacity and consolidate future working relationships.

RAMON MESSEGUER,
BIOLIGIST, SENIOR RESEARCHER,
LEITAT TECHNOLOGICAL CENTER, SPAIN

1) What would be the benefits for the public from your research/ involvement in the project?

Our team will provide clinical and biomarker data that will be integrated in the patient-specific computer models to predict knee OA onset and improve treatment. Success of this research work is expected to improve Osteoarthritis treatment, improve the quality of life of patients and will benefit future generations. Moreover, we will determine the feasibility of establishing new exosome and microbiome biomarkers for OA.

2) What could be the benefits/take-home messages for all partners involved in such an initiative?

The quality of your health and life may improve because you will play an active role in educating yourself about your health. The participants will have the privilege of assuming an active role in their health care, while taking responsibility for their health is empowering!

THIJS SWINNEN,
PHYSIOTHERAPIST, KU LEUVEN, BELGIUM

1) What would be the benefits for the public from your research/ involvement in the project?

To extend the biomedical view (disease determines outcome) on knee osteoarthritis to include the role of socioeconomic factors that impact on pain, function and quality of life.

2) What could be the benefits/take-home messages for all partners involved in such an initiative?

To design better population-based studies on the prediction of outcome in knee osteoarthritis by taking into account relevant socioeconomic factors.

ANA ALABAJOS,
MEDICAL DOC., HOSPITAL UNIVERSITY LA FE, SPAIN

1) What would be the benefits for the public from your research/ involvement in the project?

With the recruitment of healthy subjects we collect information regarding risk factors to develop OA, and if this data could be extrapolated to general population, it could help to prevent OA.

2) What could be the benefits/take-home messages for all partners involved in such an initiative?

The OActive partners can benefit from the exchange of ideas with colleagues from different disciplines, and the knowledge of OA from different perspectives.

2. OActive Project Progress

WP4 - LEITAT

The objective is to examine the relationship between biochemical markers for OA and clinical diagnosis. Classical and new class of biomarkers (exosomes and microbiome) are included. These results are being used for the development of advanced computer modelling and simulation tools in order to be used in early diagnosis or prognosis of the osteoarthritis (OA) disease.

WP5 – KU LEUVEN

Traditionally in knee OA research, the prediction of pain and function relies on knee-related biological factors, such as cartilage damage or joint inflammation. In WP 5 the role of socioeconomic factors on the outcome of knee OA is evaluated. To answer this question, a comprehensive framework is beign developed to operationally define socioeconomic and environmental factors based on the World Health Organization's International Classification of Functioning, Disability and Health (ICF). Currently a systematic literature review (7639 studies) is being finalised to assess the impact of socioeconomic factors on key outcomes in osteoarthritis focusing on pain, function and quality of life. Popular socioeconomic factors in knee OA research, included race, education, employment, poverty and income, as well as family composition. Nevertheless, a large variety of socioeconomic outcome measures was found. Complete data extraction, fuelling the risk of bias assessment, is in its final phase. Preliminary analysis confirms a role for socioeconomic factors on the outcome of knee OA, for which outcome measures should be standardised across studies for future comparison.

WP6 - CERTH - CETRI

The work performed under this WP can be summarized below. The OActive team managed to: (i) Provide a robust feature selection (FS) approach that could identify important risk factors which contribute to the prediction of Knee Osteoarthritis (KOA) and (ii) to develop machine learning (ML) prediction models for KOA. The current study considers multidisciplinary data from the osteoarthritis initiative (OAI) database, the available features of which come from heterogeneous sources, such as questionnaire data, physical activity indexes, self-reported data about joint symptoms, disability and

2. OActive Project Progress

function as well as general health and physical exams' data. The novelty of the proposed FS methodology lies on the combination of different well-known approaches including filter, wrapper and embedded techniques, whereas feature ranking is decided on the basis of a majority vote scheme to avoid bias. The validation of the selected factors was performed in data subgroups employing seven well-known classifiers in five different approaches. A 74.07% classification accuracy was achieved by SVM on the group of the first fifty-five selected risk factors. The effectiveness of the proposed approach was evaluated in a comparative analysis with respect to classification errors and confusion matrices to confirm its clinical relevance. The results are the basis for the development of reliable tools for the prediction of KOA progression.

Moreover, under the OActive project a cloud-based platform is for the clinical data gathered from clinical researcher centers and rehabilitation & recovery centers is developed. The database and the corresponding APIs for uploading and downloading the data have been finalized. The cloud-based infrastructure for the ML models, as well as the anonymization of the critical data is under-development.

WP7 – UPATRAS

The team's efforts so far were focused mainly on the improvement of the musculoskeletal analysis back-end and the development of a complete DSS platform for the clinician, since they both are considered imperative elements of a successful AR gamification platform targeting the patients. There has been substantial progress in developing a game system that utilizes a set of gamification core drives which are based on similar game designs that are already successful, such as many rhythm games. Finally, the implementation of the game API supporting both the local machine and multiple network devices fulfils the need of a complete game design if that need arises. The complete system of gait retraining was implemented providing a set of customizable gamification features for monitoring, such as indication bars and texts. A specific exercise agnostic design was developed, which supports the definition of multiple exercises and promotes the extensibility of the system to different rehabilitation scenarios. Nevertheless, the main supported exercise for now is the walking exercise that is originally selected for the OActive project. Finally, the system now supports PCs

2. OActive Project Progress

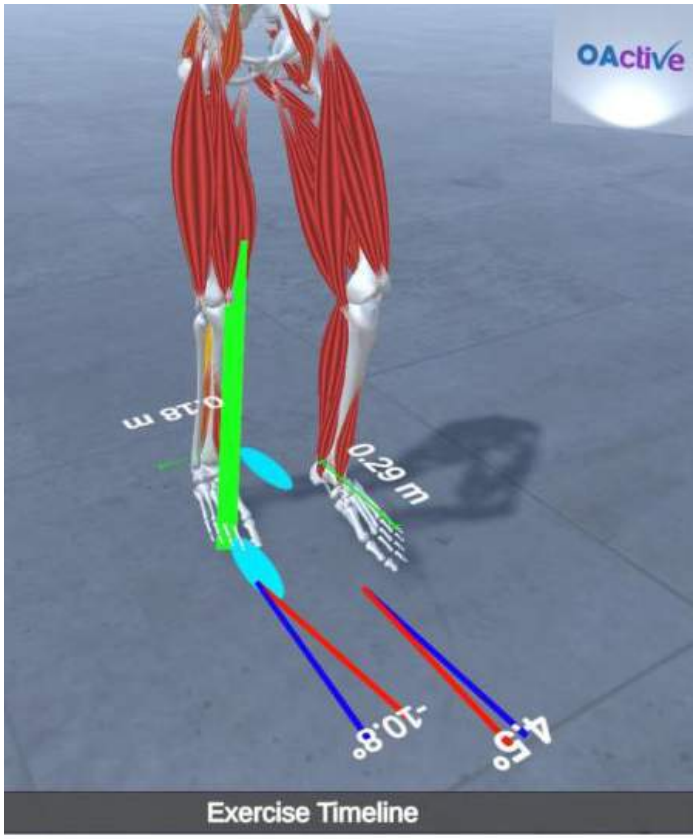
running Windows, Android tablets, AR Meta 2 HMD and the web front-end supports browsers of any device (Android tablets, smartphones, Linux PCs etc.).

WP8

The consortium has successfully developed an OA in vitro model based on viable osteochondral tissues. Such model was realised inducing a LPS-mediated inflammation on healthy cartilage and bone. Intriguingly, histochemistry analyses showed the presence of the characteristic signs of OA (e.g. cartilage fibrillation in the superficial zone, chondrocytes hypertrophy) after LPS stimulation. This evidences was confirmed by immunohistochemistry analyzes, which unveiled the involvement of several enzyme-catalysed pathway in the OA development. More interestingly, tissue integrity was fully restored after treatment with the anti-inflammatory drug Rapamycin. This evidence suggests for a dynamic stimuli-responsive properties of the model, which mimics a native OA tissue.

WP9 – HULAFE

Subjects among different populations, such as elderly people with advanced OA, healthy subjects in risk of developing OA and athletes with post-traumatic OA, have been recruited among the three clinical partners (UNIC, HULAFE, ANIMUS). In these subjects, a clinical evaluation, biological tests, X-rays, MRIs and gait analysis, were performed. All the data obtained in this WP is shared with the consortium for the design of the models.



OActive

3. Latest Consortium Meetings

14TH MAY, 2019

LUXEMBURG, REVIEW MEETING

25TH-26TH NOV. 2019

PALERMO, ITALY, CONSORTIUM MEETING

19TH NOV. 2019

ONLINE MEETING, REVIEW MEETING

4. OActive's 2nd Training Session

AXIA organized the 2nd training session of OActive (May 29, 2020) with title "Engaging end-users to the OActive world". Due to the COVID-19 pandemic, the training session was held online using the Google Meet platform. 234 registrations were recorded with around 120 attending the live session, engaging in a dialogue with the presenters and illustrating their interest in OActive's work.

UNIC, LEITAT, SMARTEX, CERTH, LJMU, RIMED, and UPATRAS all presented an overview of their work in the 4 sections of the training:

- Introduction
- Biomarkers and biomechanics
- Computational modelling & validation
- Personalized interventions

4. OActive's 2nd Training Session

OActive's objective is to support prevention and diagnosis but also delayed progression of OA by bringing the scientific expertise and the OActive technologies closer to interested stakeholders. The training focused on presenting and analyzing the achievements of the project but also highlighting its impact to patients and their families!

5. OActive's AWARDS

Dr. Riccardo Gottardi, PI

Affiliation: RIMED

Research interests: Tissue Engineering, Bioreactors, Nanotechnology, Controlled Release, Cartilage

Dr Riccardo Gottardi has received the Young Investigator award from the journal "Cell, Tissues, Organs" for his work on the regenerative response of cartilage to different loading regimens. The journal focuses on cell and developmental biology, stem cell research, tissue engineering, in vitro systems and regenerative biology.

6. OActive Publications

• ENDOTHELIAL CELLS SUPPORT OSTEOGENESIS IN AN IN VITRO VASCULARIZED BONE MODEL DEVELOPED BY 3D BIOPRINTING

Authors: Irene Chiesa, Carmelo De Maria, Anna Lapomarda, Gabriele Maria Fortunato, Francesca Montemurro, Roberto Di Gesù, Rocky S Tuan, Giovanni Vozzi and Riccardo Gottardi.

Partner: RIMED
Journal: 2020 Biofabrication

DOI: https://doi.org/10.3390/app10196797

• MACHINE LEARNING IN KNEE OSTEOARTHRITIS: A REVIEW

Authors: C. Kokkotis, S. Moustakidis, E. Papageorgiou, G. Giakas, D. E. Tsaopoulos
Partner: CERTH
Journal: Osteoarthritis and Cartilage Open

DOI: https://doi.org/10.1016/j.ocarto.2020.100069

• COMPARATIVE ANALYSIS FOR COMPUTER-BASED DECISION SUPPORT: CASE STUDY OF KNEE OSTEOARTHRITIS

Authors: Philippa Grace McCabe, Ivan Olier, Sandra Ortega-Martorell, Ian Jarman, Vasilios Baltzopoulos, Paulo Lisboa
Partner: LJMU
Proceedings: Intelligent Data Engineering and Automated Learning – IDEAL 2019

LINK: https://books.google.gr

• PHYSICAL ACTIVITY AS A RISK FACTOR IN THE PROGRESSION OF OSTEOARTHRITIS: A MACHINE LEARNING PERSPECTIVE

Authors: Antonios Alexos, Serafeim Moustakidis, Christos Kokkotis, Dimitrios Tsaopoulos
Partner: CERTH
Proceedings: Intelligent Data Engineering and Automated Learning – IDEAL 2020

LINK: https://www.springerprofessional.de

OActive

6. OActive Publications

• IDENTIFICATION OF RISK FACTORS AND MACHINE LEARNING-BASED PREDICTION MODELS FOR KNEE OSTEOARTHRITIS PATIENTS

Authors: Christos Kokkotis, Serafeim Moustakidis, Giannis Giakas and Dimitrios Tsaopoulos
Partner: CERTH
Journal: Applied Sciences

DOI: https://doi.org/10.3390/app10196797

• A MACHINE LEARNING PIPELINE FOR PREDICTING JOINT SPACE NARROWING IN KNEE OSTEOARTHRITIS PATIENTS

Authors: C. Ntakolia, C. Kokkotis, S. Moustakidis, D. Tsaopoulos
Partner: CERTH
Proceedings: 20th IEEE International Conference on BioInformatics and BioEngineering (BIBE2020)

• A MACHINE LEARNING WORKFLOW FOR DIAGNOSIS OF KNEE OSTEOARTHRITIS WITH A FOCUS ON POST-HOC EXPLAINABILITY

Authors: C. Kokkotis, S. Moustakidis, E. Papageorgiou, G. Giakas and D. Tsaopoulos,
Partner: CERTH
Proceedings: The 11th International Conference on Information, Intelligence, Systems and Applications (IISA2020)

• PREDICTION OF PAIN IN KNEE OSTEOARTHRITIS PATIENTS USING MACHINE LEARNING: DATA FROM OSTEOARTHRITIS INITIATIVE

Authors: A. Alexos, S. Moustakidis, C. Kokkotis, E. Papageorgiou, G. Giakas, D. Tsaopoulos
Partner: CERTH
Proceedings: The 11th International Conference on Information, Intelligence, Systems and Applications (IISA2020)

OActive

7. Attendance to Events

BIBE 2020

THE 20TH IEEE INTERNATIONAL CONFERENCE ON BIOINFORMATICS & BIOENGINEERING

October 26-28, 2020 USA

CERTH participated at the 20th IEEE International Conference on BioInformatics And BioEngineering, that was held virtually. The conference aims at building synergies among the complimentary disciplines of Bioinformatics, Bioengineering and Biomedical. These synergies have delivered advances for understanding a wide range of complex issues and problems in the fields of medicine, bioengineering and biological systems, health environmental science, public healthcare, food, forensics, wearable and assistive devices and more.

IISA 2020

THE 11TH INTERNATIONAL CONFERENCE ON INFORMATION, INTELLIGENCE, SYSTEMS AND APPLICATIONS, VIRTUAL CONFERENCE

15 – 17 July, 2020, Piraeus, Greece

The International Conference on Information, Intelligence, Systems and Applications (IISA) series offers a forum for the constructive interaction and prolific exchange of ideas among scientists and practitioners from different research fields – such as computers, mathematics, physics, biology, medicine, chemistry, experimental psychology, social sciences, linguistics, and engineering – having the goal of developing methodologies and tools for the solution of complex problems in artificial intelligence, biology, neuroscience, security, monitoring, surveillance, healthcare, sustainability in energy sources, governance, education, commerce, automation, robotics, optimization, image, speech and natural languages, and their integration. CERTH attended the online IISA conference presenting their work performed under the OActive project.

LION 14

LEARNING AND INTELLIGENT OPTIMIZATION CONFERENCE, VIRTUAL CONFERENCE,

24 - 28 May 2020, Athens, Greece

CERTH attended the LION14 conference that was held online from 24-28 May 2020. The meeting explores the interactions between machine learning, artificial intelligence, energy, mathematical programming and algorithms for hard optimization problems. The main purpose of the event is to bring together experts from these areas to discuss new ideas and methods, challenges and opportunities in various application areas, general trends and specific developments.

OActive

8. Upcoming Events

CONFERENCES THE OACTIVE CONSORTIUM WILL ATTEND

1. IEEE INTERNATIONAL CONFERENCE ON BIOINFORMATICS AND BIOMEDICINE, DECEMBER 16-19 2020, ONLINE

The IEEE International Conference on Bioinformatics and Biomedicine (BIBM) has established itself as the premier research conference in bioinformatics and biomedicine. IEEE BIBM 2020 provides a leading forum for disseminating the latest research in bioinformatics and health informatics. It brings together academic and industrial scientists from computer science, biology, chemistry, medicine, mathematics and statistics. We solicit high-quality original research papers (including significant work-in-progress) in any aspect of bioinformatics, genomics, and biomedicine. New computational techniques and methods and their application in life science and medical domains are especially encouraged.

2. OARSI 2021, APRIL 29 – MAY 2 2021, DENVER USA

OARSI 2021 is one of the most well-known Osteoarthritis conferences on the international level. After cancelation of the OARSI 2020 congress due to the COVID-19 pandemic, in 2021 the conference will be organized in Denver, USA, posing a first-class opportunity for the relevant researchers and stakeholders to meet again.

OActive

8. Upcoming Events

3. 15TH INTERNATIONAL SOCIETY OF PHYSICAL AND REHABILITATION MEDICINE WORLD CONGRESS, JULY 03-07 2022, LISBON PORTUGAL

ISPRM is the global agency for Physical and Rehabilitation Medicine (PRM), a non-governmental organization, in relation with the World Health Organization (WHO) and the United Nations (UN) and the international umbrella organization of PRM physicians. ISPRM is the highest academic organization of PRM around the world and the ISPRM congress plays a major role in enhancing medical technology, strengthening academic exchanges and promoting collaborative research and exploration in rehabilitation medicine and related disciplines. The objective of the conference is to facilitate the spread and exchange of knowledge, skills and attitudes between experts, researchers, clinicians and trainees, and aiming to continue developing the ISPRM and PRM.

4. ESPRM 23RD EUROPEAN CONGRESS OF PHYSICAL AND REHABILITATION MEDICINE

APRIL 26-30 2022, LJUBLJANA, SLOVENIA

8. Upcoming Events

OTHER RELEVANT CONFERENCES

1. 2021 WORLD CONGRESS ON OSTEOPOROSIS, OSTEOARTHRITIS AND MUSCULOSKELETAL DISEASES, AUGUST 26- 29 2021, LONDON UK

The members of the Committee of Scientific Advisors of the IOF and the members of the Scientific Advisory Board of ESCEO are developing a very exciting Congress' scientific program that will bring together the world's best in the field of musculoskeletal health and disease. The International Osteoporosis Foundation (IOF) and the European Society for Clinical and Economic Aspects of Osteoporosis and Osteoarthritis (ESCEO) organized the conference with the scope of moving the field one step forward on all fronts; from new understanding of bone metabolism and pathology, to new strategies and options in prevention, diagnosis and treatment.

2. 6TH INTERNATIONAL CONFERENCE ON SPORTS MEDICINE AND FITNESS, NOVEMBER 23-24 2020, WEBINAR

The 6th International Conference on Sports Medicine and Fitness focuses on Sports Medicine and Science, Physical Rehabilitation and Orthopedic Sports science. Remarkable relevance and interest for the OActive partners and the development of the project.

OActive

8. Upcoming Events

OTHER RELEVANT CONFERENCES

3. ICHABD 2021 – INTERNATIONAL CONFERENCE ON HEALTHCARE AND BIG DATA ANALYTICS, NOVEMBER 18-19 2021, PARIS FRANCE

The conference aims to bring together leading academic scientists, researchers and research scholars to exchange and share their experiences and research results on all aspects of Healthcare Analytics and Big Data. It also provides a premier interdisciplinary platform for researchers, practitioners and educators to present and discuss the most recent innovations, trends, and concerns as well as practical challenges encountered and solutions adopted in the fields of Healthcare Analytics and Big Data.

4. INTERNATIONAL CONFERENCE ON HEALTH ANALYTICS, DECEMBER 10-11 2020, LONDON UK

International Conference on Health Analytics targets on scientists and researchers to exchange and discuss on the new scientific aspects of Health Analytics such as recent innovations, trends, and concerns as well as practical challenges encountered and solutions adopted in the fields of Health Analytics.

5. WBC 2020 WORLD CONGRESS OF BIOMATERIALS 2020, VIRTUAL CONFERENCE 11-15 DECEMBER, 2020, GLASGOW, UK

RIMED will participate at the WBC2020, having the opportunity to attend to presentations from world leaders and experts, ePoster presentations, as well as a parallel virtual exhibition including B2B meetings with industrial partners. The World Biomaterials Community provides a global forum for biomaterials professionals to share knowledge, discover insights, network and discuss trending topics.

9. OActive Community

The OActive consortium is broadly disseminating the OActive goals and progress in order to increase social awareness, to steer SMEs and other stakeholder engagement, to attract additional future funding and to increase the project's commercial exploitability. To this end, all project partners are actively contributing to the creation of a structured and critical OActive community which comprises associations and other EU funded projects.

In more detail, we have reached out to more than 15 EU funded projects with whom OActive shares several common research goals, with the aim to engage in common dissemination and communication activities and sharing lessons learnt. We have also identified and reached out to more than 40 associations and social parties, such as Hospitals, Clinics, Rehabilitation Centers, Research Centers, NGOs and International & European Organizations. Some of the relevant associations are provided below.

10. Deliverables & Milestones

LATEST DELIVERABLES

WP1	***D1.4.*** First version of IPR plan (Conf., M18)
WP3	***D3.1.*** OACTIVE personalized computer biomechanical models (Pub., M24)
WP4	***D4.1.*** Documentation on the qualification of biomarkers found in serum of OA patients (Pub., M28)
WP5	***D5.1.*** User Behaviour Modelling Documentation (Pub., M18) ***D5.3.*** Documentation of social attributes and interdependencies of cognitive and social determinants (KU Leuven)
WP6	***D6.1.*** Data Management Infrastructure (Pub., M23) ***D6.2*** System integration architecture (Conf., M25)
WP7	***D7.2*** Beta version of the Synthesized AR game system (Conf., M28) ***D7.3*** Final Synthesized AR game system (UPAT)
WP8	***D8.2*** OA in vitro models (Pub., M16) ***D8.3*** Effects of hormones during OA (Pub., M18)
WP10	***D10.2.*** Training seminars (2) (Pub., M28)

MILESTONES

MS5
Integrated System validated
(M42)

MS4
Hyper-modelling framework completed
(M41)

MS3
All modelling approaches completed
(M41)

MS2
First version of AR game system
(M28)

MS1
User requirements, use cases according to end users feedback; system architecture designed
(M6)

OActive

Our YouTube Channel

Click here!

OActive on YouTube SUBSCRIBE!!!

https://www.youtube.com/channel/

PROJECT COORDINATOR:
University of Nicosia
Makedonitisas Avenue 46, Nicosia
P.O. BOX 24005, 1700, Cyprus
TEL. +357 22 841 528
EMAIL: info@oactive.eu

11. The Consortium

Join us at:

OActive

13 PARTNERS

7 COUNTRIES

3 YEARS

5M. FUNDING

Project Title:
Advanced personalised, multi-scale computer models preventing osteoarthritis
SC1-PM-17-2017 – Personalised computer models and in-silico systems for well-being
Type of action: Research and Innovation action (RIA)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Grant Agreement No. 777159.