

An imec.icon research project | project results





Providing healthcare professionals with a better, affordable and evidence-based tool to improve pathology diagnosis and initiate personalized therapies – using MSI technology

To diagnose cancer and determine the most appropriate treatment, pathologists commonly use an approach called 'visual histopathology' – using microscopes to study patients' cells and tissues. Yet, visual histopathology has its limits and is not always very accurate. For instance, tumors with the same histopathological features can have very different clinical causes and require different treatments. Hence, a proper classification of tissue samples is crucial.

One highly promising alternative to analyzing tissues leverages mass spectrometry imaging (MSI), which makes it possible to determine the exact spatial distribution of chemical compositions (compounds, biomarkers, proteins, etc.) in any given tissue. Moreover, it comes with the additional benefit that a very large range of molecules can be analyzed at once. But as MSI is a relatively new technology, it still faces some challenges which prevent it from being used in clinical routine.

"The use of MSI still comes with some important drawbacks – such as the need for expensive equipment and expert knowledge in informatics, as well as the computational difficulties related to extracting meaningful facts from very big and complicated datasets," explains Xian Mao (imec - KU Leuven). "Through MSIpad, we wanted to further explore the potential application domains of MSI technology, address some of its shortcomings and contribute to making MSI commonly available to pathologists and pharmaceutical researchers as an objective decision-support tool."

MSIpad focused on two use-cases. The first one included a better and more accurate diagnosis of lymphomas to facilitate a more accurate treatment, better chances of recovery and a decrease of the related medical costs. The second use-case dealt with a more efficient discovery and development of diabetes medicines by enabling a quick analysis of the molecular changes they provoke.

THE OUTCOMES

A fully functional software prototype that is 2x more cost-effective and 10x faster to use than current histopathology approaches

MSIpad resulted in the creation of a fully functional MSI software prototype that is 2 times more cost-effective and 10 times faster to use than current histopathology approaches.

To achieve this, the project partners studied approaches that allow users to immediately focus on the specific region in the tissue where a pathology occurs – rather than having them analyze the complete sample. MSIpad concretely proposes a combination of hardware and software innovations that result in a digitized version of the sample (digital pathology), allowing users to zoom in on any given region (40x) and complement that high-resolution visual input with MSI's molecular information (down to 10 μ m) to easily spot the region that matters.

Secondly, the team looked into solutions to tackle the 'big data' that result from using high-resolution mass spectrometry imaging – with up to 30GB of data being generated in about four hours. Hence, MSIpad developed big data analytics algorithms to automatically make sense of all these complex data.

2. A pipeline descriptor and user-friendly interface that allow non-specialists to exploit MSI's full potential

MSIpad investigated how non-expert users (such as pathologists and pharmaceutical researchers) can optimally be supported by MSI technology in their daily clinical routines. Hence, in addition to developing a fully operational MSIpad software prototype, the project partners created an alpha version of a user-friendly interface that makes it easier for non-specialists to exploit the full potential of MSI (and the resulting big data stream). Moreover, MSIpad resulted in a pipeline descriptor that details how MSI technology should be used in clinical settings in the most optimal way – from dealing with the tissue up to the actual diagnosis.

3. A library of predefined molecular profiles – related to MSIpad's two use-cases

An important contribution to the work of pathologists and pharmaceutical researchers, a library of predefined molecular profiles (corresponding to the various disease states of MSIpad's two use-cases) was built; comprehensive molecular profiles that had not been documented before.

NEXT STEPS

"The pathologists and pharmaceutical researchers that have already used the MSIpad prototype were pretty amazed by the progress we have made – as they realize that current approaches cannot provide them with the same insights," says Xian Mao. "And – ultimately – this research should obviously result in quite some societal advantages as well – with patients getting diagnosed more quickly, with personalized and optimized therapies being initiated, and the overall healthcare cost going down. And the same goes for drug discovery processes, which can significantly be sped up using MSI technology."

"In the longer term, there is definitely an opportunity to commercialize the MSIpad projects results – but this requires further development and usability testing of our prototype," she concludes.

AGENTSCHAP INNOVEREN & ONDERNEMEN Vlaanderen is ondernemen

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NAME	MSIpad
OBJECTIVE	Providing healthcare professionals with a better, affordable and evidence-based tool to improve pathology diagnosis and initiate personalized therapies – using MSI technology
TECHNOLOGIES USED	rapifleX [™] MALDI Tissuetyper [™] (Bruker Corporation); Pathomation
ТҮРЕ	imec.icon project
DURATION	01/01/2015 - 31/12/2016
PROJECT LEAD	Wim Waelput, Pathomation
RESEARCH LEAD	Xian Mao, imec - STADIUS - KU Leuven
BUDGET	523,990 euro
PROJECT PARTNERS	Pathomation, reMYND, UZ Gasthuisberg
RESEARCH PARTNERS	KU Leuven - Laboratory of Protein Phosphorylation and Proteomics
IMEC RESEARCH GROUPS	STADIUS - KU Leuven



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