M3S project – benefit for patients

Molecular Signature Detection with Multi-Modal Microscopy Scanner

ADDRESSED ISSUES AND PROPOSED M3S SOLUTION

In many medical disciplines (e.g. histopathology, cytology, cyto-haematology, parasitology), microscopic morphology based on staining and identification of molecular markers (immunohistochemistry) is the "gold standard" for an initial diagnosis and a treatment referral. Yet these techniques do not provide all the answers, especially when it is critical to obtain an early diagnosis, to determine an unknown diagnosis (grey areas), to monitor the progression of the disease or to decide on a personalized treatment. In addition, they are complex to be implemented and standardized and require significant human resources, while the number of specialists is decreasing. Interestingly, bio-photonics technologies like vibrational spectroscopy (Raman and infrared) provide unique fingerprinting capabilities that have produced evidence of concepts on various topics, and are mature enough for evaluation in real-life conditions. Particularly, Raman micro-spectroscopy provides intrinsic molecular information on individual cells and is well suited for complementing morphological microscopy. Associated to an automation of data collection and analysis, such solutions could constitute powerful instruments for better care of patients. Preliminary results obtained thanks to a first prototype developed with clinician contribution are encouraging and led us to propose the M3S project which is aimed at associating complementary technological options in order to scan biological samples, acquire molecular fingerprints on cells or cell compartments, and then classify and analyse the data providing key elements for the optimization of treatments.

BETTER DECISION FOR OPTIMIZED TREATMENT

In pathology, decision to treat varies greatly according to the exact diagnosis and progression of the disease. Without a perfect diagnosis, physicians can thus face difficulties to select and adapt the treatment. **Solutions for more accurate diagnosis and more sensitive monitoring of disease progression are then strongly needed** with the aim of providing an efficient support to decision for clinicians and pathologists. To achieve these unmet needs, consortium partners have developed a prototype solution that will be tested and adapted for a suitable use in clinical settings. By improving the robustness, speeding the treatment of data and adding an innovative multi-variate classification tool that uses patient data in addition to the existing morphology/spectroscopy data classifier on individual cells, M3S intends to fulfill a series of needs: i) simplification/standardization of sample preparation, ii) quick analysis of samples (tens of minutes), iii) early detection of pathological situations (before the appearance of morphological signs), iv) detection of innovative markers specific for given pathologies and v) support to the selection of personalized treatments. Although evaluated in the case of two specific pathologies (Chronic Lymphoid Leukaemia (CLL) and malaria), the solution can find applications in many other

Usage

a blood test will be performed on patient with suspected Leukaemia or Malaria. The practitioner will position the blood smear on the scanner and start the automatic scan and will collect the results after about ten minutes in the format of an analytical report including the parasitaemia, the class of the parasite or the prognosis prediction of the disease for haematology.

Technology

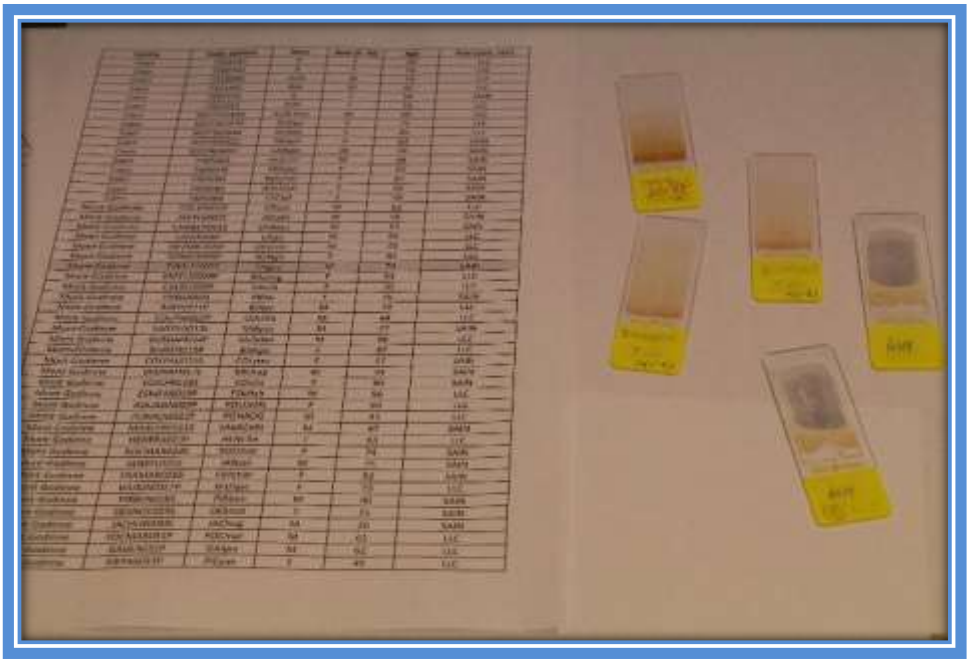
The global M3S platform will include three major components making use of various technologies:

1) A biophotonics-based imaging instrument associating a Raman micro-spectrometer, basic microscope accessories and fast motorized functionality and an accurate XYZ stage controller to scan unstained samples and acquire spectral signatures. These constitute the hardware platform.

based on top of the existing TRIBVN platform and l the different hardwares and optics instruments to localize erest and capture exploitable data

3) A data extractor and analyzerbased on the Q Finder® algorithm detecting and characterizing molecular signatures through exhaustive exploration of multivariate data.

clinical contexts (such as melanoma, breast cancer, thyroid cancer) targeting a wider range of users.



PERSPECTIVES

M3S technologies will begin as "niche technologies", firstly dedicated to cyto-haematology and parasitology that will constitute the first steps before spreading into oncological histopathology (e.g. melanoma, breast and thyroid cancers) and infectious diseases (e.g. bacteriology and mycology). It should therefore in the near future (next 10 years) become an important technology that will complement and sometimes replace the current diagnostic technologies.

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