PROJECT PROFILE

CAT406

Affordable mammography detector improves image quality while reducing X-ray dose and discomfort [NEMADE]

NEMADE will develop new and less expensive X-ray detectors for mammography, resulting in higher image quality at a lower X-ray dose for patients. Improved detection techniques combined with an extremely small chest-wall distance will lead to more accurate detection and thus to more efficient breast cancer treatment. Furthermore, new minimal breast-compression technologies based on optimised pressure will significantly reduce patient discomfort.

Mammography, a specific type of breast imaging that uses low-dose X-rays, is deployed in screening programmes and diagnostics for the early detection of breast cancer when it is most treatable. There are a growing number of countries that introduce screening programmes for women between the ages of 50-74, an age group where mammography screening has the most added-value in reducing the cost of curing and saving lives. Because screening programmes apply to a large population, and diagnostic programmes only to specific cases, the vast majority of mammograms are made for screening purposes. X-ray based mammography is the only equipment used in screening, for cost and effectiveness reasons, and is expected to remain the preferred procedure for the foreseeable future. Recent studies show that the results of the current 2-dimensional (2D) technology for screening mammography are significantly improved by applying digital breast tomosynthesis (DBT), where a 3-dimensional reconstruction of the breast is obtained, avoiding the superimposed tissues, which is the case with 2D. Importantly, DBT needs fast and low-dose detection.

Now, current mammography technology uses selenium to directly convert X-rays into electrical signals. However, this technology is too slow for the new DBT technique, and also expensive and very sensitive to environmental variations. In addition currently used caesium-iodide (CsI) scintillators – an indirect converter that luminesces when struck by an incoming X-ray, absorbing its energy and re-emitting it in the form of visible light – are quite sensitive to environmental conditions and difficult to integrate with CMOS (complementary metal-oxide semiconductor, the technology used in transistors manufactured for today's microchips). On the other hand, the CsI indirect conversion material is faster and more stable to environmental influences, but has lower resolution than the indirect conversion material, Se. Therefore structured CsI, which has a higher resolution than the conventional CsI scintillator, is being also developed in this project. These are some key justifications for the NEMADE project.

Improving diagnosis efficiency and safety, reducing costs

NEMADE aims at developing a new, less expensive generation of mammography detectors. The use of butted CMOS tiles and structured CsI scintillators – a unique combination for mammography – will result in much better image quality at a lower X-ray dose, and will be suitable for screening, biopsy and tomosynthesis. Furthermore, new optimised minimal breast-compression technologies, in combination with an extremely small chest wall distance, will result in increased personalised mammography.

The five main technical goals are:

1. More efficient X–ray energy conversion by improved scintillator performance;
2. Enhanced detector performance by using the newest generation CMOS imagers allowing additional features like switchable saturation dose, dual-energy compatibility and real-time X-ray dose sensing and control; and improved imaging processing capabilities;
3. Improved assembly technology matching the stringent requirements for high-resolution mammography applications, combined with high reliability;
4. More personalised mammography and higher patient safety by adaptive breast compression, reduced X-ray dose and shorter imaging cycles, fewer re-takes, and fewer incorrect screening diagnosis results;
5. Lower detector costs, lower cost-of-ownership and more efficient diagnosis and treatment.

PROJECT CONTRIBUTES TO

- Health and aging society
- Manufacturing science

PARTNERS

Teledyne DALSA
SigmaScreening
Scint-X

COUNTRIES INVOLVED

- Netherlands
- Sweden

PROJECT LEADER

Jan Bosiers
Teledyne DALSA, Netherlands

KEY PROJECT DATES

January 1, 2015 - December 31, 2017

Related strategic and business goals are:

- Make Europe the leading supplier of high-end mammography detectors combining the best of patient safety and comfort with a new generation of affordable high-tech systems. Currently, this market is dominated by the USA and Canada;
- Consolidate the position of Europe as leading supplier of CMOS-based X-ray detectors for medical and extra-oral dental applications by adding mammography to the list of clinical applications;
- Strengthen the position of Europe as supplier of high-end scintillators for a wide range of medical applications. The high-end CsI scintillator market is currently dominated by overseas companies. The technologies developed in this project for mammography can be applied also to applications like surgery, extra-oral dental, fluoroscopy and cardio-vascular;
- Establish Europe as the leading player in personalised mammography screening using an innovative breast compression approach;
- Support the drive for sustainable health care through lower detector costs and lower cost-of-ownership.

Specialist European collaboration

The consortium brings together three European partners from the Netherlands and Sweden who are leaders in their specific technology areas (CMOS-based medical X-ray detectors, personalised mammography and structured scintillators). They combine complementary technological knowledge and have a complete overview of the application requirements. Combining their market intelligence, customer and supplier contacts and benchmark information, project partners can define the relevant target specifications for a novel mammography demonstrator and successfully meet all technical and commercial challenges.

Societal impact

Improved detection techniques, which are also affordable, will lead to more accurate and earlier detection, with less false positives and thus to more efficient treatment of breast cancer. This will enable higher efficiency and cost reduction in health care even in emerging market economies. Reduced pain during examination, fewer screenings and higher screening accuracy will also result in a higher percentage of women participating in the screening programmes (fewer no-shows) and with fewer complications. And a reduced X-ray dose is safer for the patient.

Healthy market conditions

Future market conditions for NEMADE's deliverables look good. The key drivers for overall mammography demand are screening programmes. In most countries these facilities are regulated by the government, and introducing such a programme will create a peak in equipment demand. More and more countries are adopting screening programmes. In high GDP countries the equipment is mostly digital.

There are two key reasons why screening programmes are taking off in emerging markets. Firstly, as income per capita grows in these markets, a larger percentage of income is spent on health care. For example, in the USA it is 17% of GDP and in Mexico 6%. Secondly, as income grows, the population tends to adopt a more Western lifestyle, which leads to a higher incidence of breast cancer (for some inexplicable reason). There are around 40,000 mammography machines in use, and some 6,000 new ones are produced and sold every year. The total mammography system market is around €900m. The European market is worth €350m, while US and Asia-Pacific markets are €420m and €130m, respectively. Growth rates are estimated at approximately 4.5% per year in Europe, 1.2% in the USA and 6.7% in Asia Pacific.

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