

## Photoacoustic Imaging: Technology, Systems, Market and Trends

*From research labs to clinical products*

***Release announcement***

TEMATYS and LMDC are pleased to announce the release of their new market and technology report "Photoacoustic Imaging: Technologies, Systems, Market and Trends".

*Sale price: 4.990,00 € HT*

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**Abstract.** *This report studies Photoacoustic Imaging Technologies and Systems from research labs to clinical products and provides an understanding of the market, current and future trends.*

Since the first images obtained in 2000, Photoacoustic Imaging has raised more and more interest for biomedical and medical applications. First applications were found in Research and Development. A lot of Proofs of Concept for in vitro and in vivo diagnostics and monitoring have been established.

Currently, PAI is spreading to biomedical and medical markets. The 3 main segments are:

- Pre-clinical (drug efficiency monitoring on small animal),
- Analytics (microscopy, flow cytometry for in vitro diagnosis),
- Clinical (early stage diagnosis).

In 2016, the total PAI biomedical and medical market was worth \$ 35M, due to the Pre-clinical and Analytics segments only. It is forecasted to reach around \$ 240M in 2022. A sharp increase is expected starting from 2018, due to the release of clinical products that are to be approved in 2017 like the « Imagio » system from Seno Medical Instruments, US (already CE marked).

Within 4 to 5 years, the clinical market is expected to become the largest segment of the PAI biomedical and medical market, ahead of Pre-clinical applications. The main applications that will benefit from PAI clinical products are cancer diagnostic, cardiovascular diseases, dermatology, brain imaging, therapy monitoring and drug developments.

In the report, each segment of the PAI market (R&D, Pre-clinical, Analytics and Clinical) is analyzed in detail. Market forecasts and perspectives up to 2022 are provided. Main players are listed and detailed.

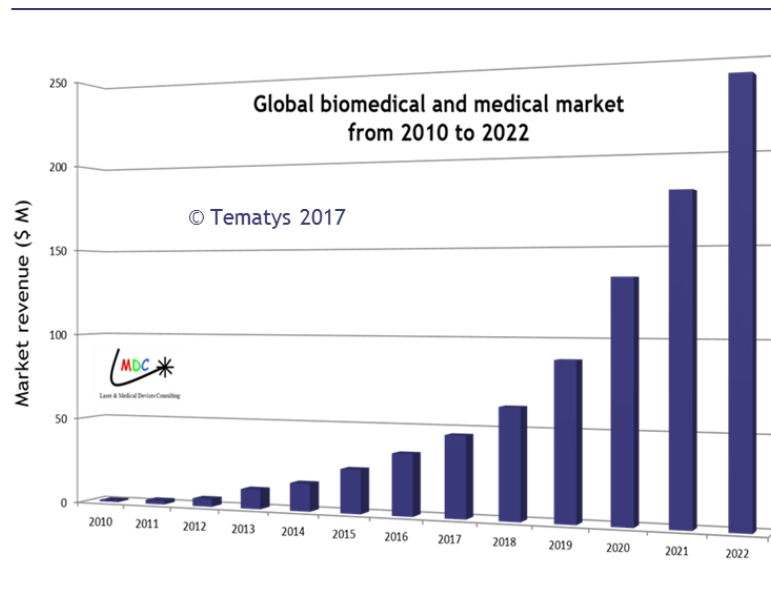


Figure 1. Global biomedical and medical market from 2010 to 2022

In healthcare and life science, there is a huge demand for high resolution imaging at high penetration depth, in real time and at an affordable price. With an appropriate combination of optical and acoustical means, added to data processing and specific algorithms, Photoacoustic Imaging offers several advantages over other biomedical and medical imaging modalities:

- **Safe and non-invasive:** it is therefore adapted for repeated use on in vivo tissues, and is suited for treatment monitoring contrary to X-rays.
- **Label-free:** avoids the issue of approved labels in in vivo imaging.
- **Speckle free:** contrary to OCT and ultrasonography. It provides higher quality images.
- **Scalable:** PAI allows to image biological objects from organelles and cells to tissues or organs, while keeping the same high depth vs. resolution ratio.
- **High penetration depth :** up to several cm, allowing to image in 3D whole organs or body parts (like breast)
- Provides **various types of information:** anatomical, functional, molecular and kinetic information.

In view of all those assets, one can wonder whether PAI could replace other techniques like X-rays for various major imagery applications like breast cancer detection and screening.

The report provides an overview of optical and acoustic technologies forming a PAI system, as well as the trends in data processing and image reconstruction algorithms. It describes in details the main features of PAI, which makes it a powerful technique for clinical applications.

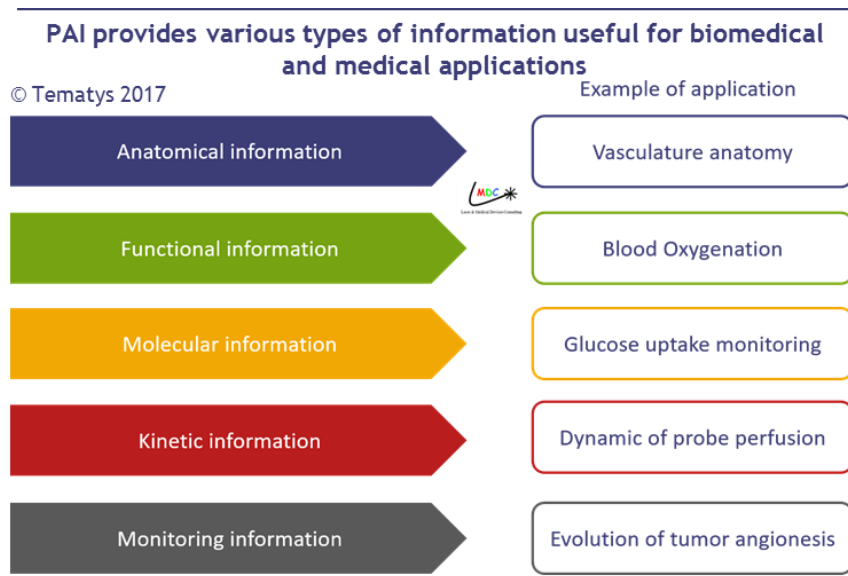


Figure 2. PAI provides various types of information useful for biomedical and medical applications

Four implementations of PAI are possible, making it a tool that easily adapts to the clinical need : handheld PAI devices (HPAT) have been developed for point-of-care applications like dermatology or oncology diagnosis at the doctor’s office.

Endoscopes integrating PAI have been demonstrated for cardio-vascular imaging inside arteries. Photoacoustic Computed Tomography (PACT) allows 3D imaging of organs. PAI can also be implemented in a microscope (PAM) for in vitro or ex vivo diagnosis.

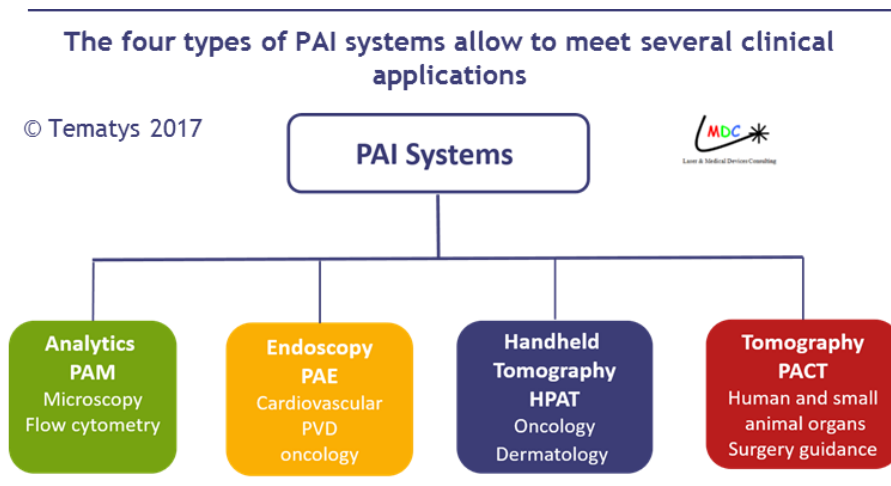


Figure 3. The four types of PAI systems allowing the meet several clinical applications

PAI is thus expected to be adopted in various clinical applications.

However, the access to the clinical market is long and complex. One of the challenges is the acceptance of PAI by clinicians. To overcome this challenge, first clinical devices expected to be adopted are systems combining Ultra-sounds and PAI. Indeed, Ultrasonography (US) is a well-known

and well-established technique. However, it provides only structural information. PAI brings functional information to US imaging.

Moreover, the entry of PAI into clinical applications is going to be boosted by the growing number of companies - startups and large firms like Fujifilm or Canon - that are investing in this technology.

In the report, we point out the remaining challenges for clinical adoption of PAI, the issues to overcome to get a large imaging market share and a roadmap of the forthcoming clinical product.

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**About TEMATYS ([www.tematys.com](http://www.tematys.com))**

TEMATYS is independent. Our team of highly qualified consultants is committed to provide a very comprehensive understanding on trends, markets and use of photonic technologies and their applications. Our services:

**➔ Reports**

- Market research
- Technological benchmark
- Prospective studies

**➔ Technology transfer & Research valorization**

- Marketing & exploitation of Research results
- Collaborative research consortia set-up
- Technology transfer strategy

**➔ Market studies & strategy**

- Market studies
- Market entry strategy & roadmaps
- Diversification
- Pre-commercial prospection

**➔ Product features definition**

- User needs - Market Requirements Document (MRD)
- Product Requirements Document (PRD)
- Feasibility studies
- Sourcing & technology assessment

Our main clients are companies of any size, from international groups to SMEs and start-up. We have also developed a special expertise in technology transfer and R&D valorization dedicated to Research Organizations and Laboratories, and we provide strategic views on optics and photonics markets for publics for clusters and public agencies.

**About LMDC (<http://www.l-mdc.fr>)**

Laser & Medical Devices Consulting (LMDC) SAS has been created on April 2010 by **Marc Faucheux** (President) with 3 Shareholders involved in Photonics and Medical Devices.

**Marc Faucheux**, Plasmas Physics PhD from *Pierre et Marie Curie University* of Paris, has worked since more than 30 years, first in Aeronautic and Spatial photonics, then as responsible of Medical Laser development at Quantel. He has acquired a large experience in strategy and photonic devices development and also for quality assurance management. Based on his experience, Marc Faucheux has developed since 2010 the consulting activity of LMDC.

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