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IPN Employs Innovative 3D Technology to Support Breast Cancer Diagnosis

- **Researcher Juan Alfonso Beltrán will participate in June at the 18th International Conference on Advanced Computational Engineering and Experimentation (ACEX) in Naples, Italy, to present his progress.**
- **Having printed models that replicate the exact structures of the breasts allows specialists to make more informed decisions for diagnosis, he explains.**

Using images obtained from computed tomography scans, Juan Alfonso Beltrán Fernández, a researcher at the Instituto Politécnico Nacional (IPN), creates digital models with specialized software. These models are then 3D-printed using resin to materialize the internal breast structures precisely. This provides specialists with a complementary tool for breast cancer diagnosis.

The novelty of this project, which is still in the research phase, lies in the use of experimental photopolymer resin. When passed through a polarizing lens, the color intensifies in areas with tumorous tissue. This is highly valuable for early-stage detection, as well as for more effective surgical planning, medical education, and patient awareness.

Dr. Beltrán Fernández, a biomechanics specialist at the Escuela Superior de Ingeniería Mecánica y Eléctrica (ESIME), Zacatenco Unit, emphasized that these tangible models are crucial for specialists. They allow for better-informed decisions and serve as valuable tools for early-stage diagnoses.

Since this technology is an innovative diagnostic tool, Dr. Juan Alfonso Beltrán Fernández will present his research findings at the 18th International Conference on Advanced Computational Engineering and Experimentation (ACEX) 2025, which will take place in June in Naples, Italy. As a result, his contributions will be published as a book chapter, and efforts will be made to register the patent with the Mexican Institute of Industrial Property (IMPI).

A Level II member of the National System of Researchers (SNII), Dr. Beltrán Fernández explained that creating these physical models involves analyzing images from CT scans,

MRIs, mammograms, and even ultrasounds. Using ScanIP software, he extracts a 3D-printable stereolithographic file (STL format).

An external viewer, Meshmixer, enables the separation, manipulation, and dynamic movement of all breast structures, from the outer skin layer to the nipple, ducts, vessels, lobes, tissues, and lymph nodes. This allows for the detection of atypical tissues, which are often associated with tumors.

Unlike conventional tomography, which relies on gray-scale interpretation, this software allows each structure to be viewed individually, offering greater diagnostic precision.

Once the digital model is complete, it is 3D-printed using photopolymer resin. "The internal structure of the entire breast physiology is printed at 80 to 100 percent of its real size, with the process taking approximately 8 to 9 hours," detailed Dr. Beltrán Fernández.

The photopolymer resins used in the prototypes have unique optical properties, making them highly sensitive. When placed in a custom-designed portable polarizer and exposed to white light, they reveal tumor presence through darkened areas.

When the model is placed under the polarizer, small stains with green and iridescent patterns appear. These visual indicators may guide doctors in deciding whether a biopsy is necessary.

The project is currently undergoing hospital validation. Once approved, it will proceed to patent registration and further studies to assess its potential use in hospitals. The expert also considers developing models using more flexible materials for surgical planning.

For more information, visit www.ipn.mx

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