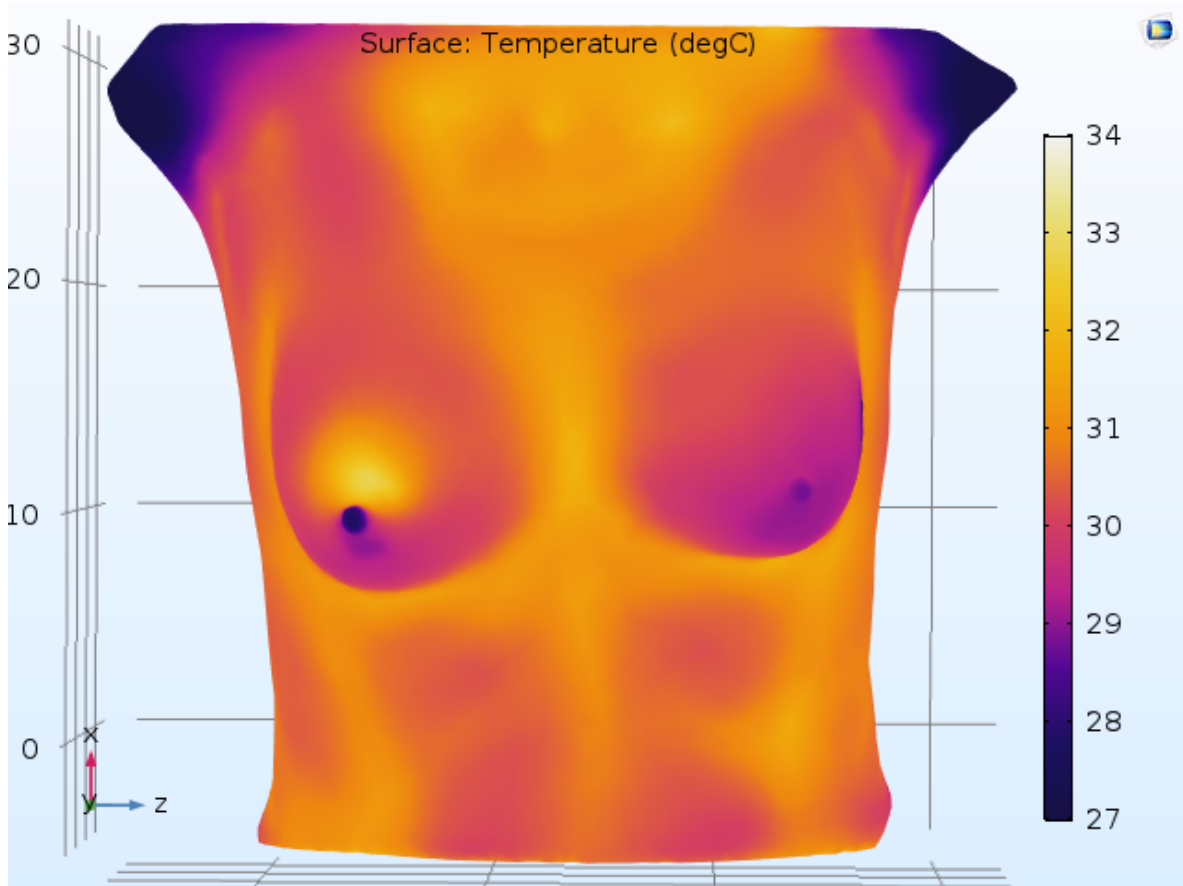


## Thermal simulation of breast tumors using 3D scans of breast cancer patients

Francisco J. González, Areli Benitez, Julián Rios

Temperature changes in the body have been recognized as an indicator of illness for centuries and localized temperature variations due to inflammatory or ischemic events are common in a great variety of diseases. In the case of cancerous breast tumors the increased cell growth rate requires larger vascularity and a higher metabolic rate which increases the temperature of the tumor compared to healthy tissue, which translates as an increase in skin temperature that can be detected with modern temperature sensors. In order to improve the effectiveness of temperature measurements for breast cancer diagnosis, more research needs to be done regarding heat transfer in healthy and cancerous tissue. A good way to understand heat transfer in biological tissue is by modeling real patients and comparing the results with actual measurements. In this work heat transfer of biological tissue was performed on a real human torso. A real scanned torso was obtained from a 3D scan performed using a hand-held scanner on a patient diagnosed with breast cancer at the Mexican Social Security Institute. Simulations of heat transfer in biological tissue were performed using COMSOL Multiphysics and its Bioheat Transfer Module. A fixed temperature boundary condition was used at the back of the model and served as the chest wall which was set to a fixed temperature of  $37^{\circ}\text{C}$ , the skin surface was considered a convective boundary condition with a heat transfer coefficient of  $15 \text{ W/m}^2\text{K}$ . The thermal parameters for healthy breast tissue and for the tumor were obtained from the literature. The results obtained are very similar to temperature measurements performed on the same patient. These results will help understand the thermal pattern of healthy and cancerous tissue and will contribute to increase the effectiveness of temperature measurements for breast cancer detection.



Thermal simulation of a 2.5 breast tumor on a 3D scanned torso of a breast cancer patient.