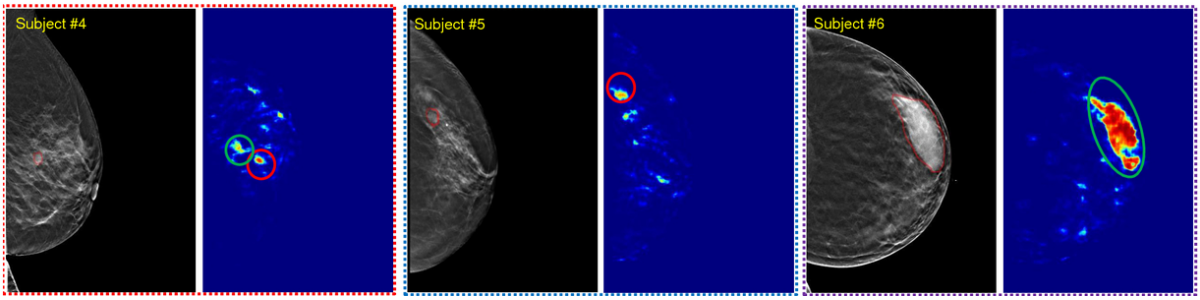
Digital Health
Personalized Medicine
Hasso-Plattner-Institut · Universität Potsdam

HPI Digital Health Center:
Research Group of Prof. Dr. Erwin Böttinger

Visualisation and Analysis of Learned Features from Deep Convolutional Networks in Breast Cancer



Motivation

Breast cancer is the most common invasive cancer in women. Worldwide, approx. 12 percent of women are affected at least once in their lifetime. Mammograms are taken for regular screening and as one of the first diagnosis steps. After 10 annual screenings, around half of patients will receive at least one false positive test. The high incidence rate and low detection specificity eagerly demand for smarter computer-aided detection (CAD) systems that support radiologists to analyse mammograms and to audit their findings.

A method for tackling various computer vision problems like image classification and object localisation are convolutional neural networks (CNNs). A CNN learns task-relevant visual features itself given training data, a learning algorithm and a loss function instead of having a human handcrafting and applying them during preprocessing. They are strong predictors and hence appear to be a practical choice for CAD.

One major issue of those systems is the lack of interpretability. Without extensive annotation efforts, they only output whether an image contains breast cancer or not. It is not comprehensible whether the model has focused on the correct criteria that experts have in mind when analysing images. If being unjustifiably trustful, false decisions can be made. On the patient side, it can i.a. lead to unnecessary anxiety and biopsies.

It is hence desirable to make machine learning models explain themselves in terms that doctors understand and use at their work. In addition, new concepts might be explored through the data-driven approach. A promising way to address these problems is to visualise and analyse features within a CNN.

Project Goals

You will help to improve the radiologist's toolkit to screen breast cancer!

First, the basis for this project is to train a CNN that can detect breast cancer on several datasets. Subsequently, you visualise the network to spot image areas that react highly for individual classes. Through user interviews with radiologists, you will identify crucial cues of breast cancer in mammograms. You will leverage this knowledge to recognise existing mental models and rules as well as to define new ones from visualisations.

Ultimately, a research prototype shall be developed and evaluated that outputs predictions on test images along with investigated explanations. The latter will be used to make high-level comparisons between cases.

What you will learn

You will acquire skills in three different areas. On the technical side, you learn to apply and visualise neural nets for vision applications and better interpretability. In the medical field, you will get insights about how radiologists work and learn their requirements for computer-aided diagnosis systems. Therefore, regular exchange with project partners is planned. Third and most importantly for your career, you will get to know how to successfully conduct a project through teamwork, commitment, planning, resource organisation & networking.

What you should bring with you

Primarily, you should have the drive to help people and an interest in the intersection of medicine and data science. It will definitely be advantageous to have participated in a machine learning course with an emphasis on neural networks. For this project, it is essential to have a pleasure to tinker with data and to discover new knowledge. Ultimately, you like to be around with likeminded and fun people.

Contact

Get in touch for questions and ideas. We are located at the Digital Health Center on campus III, Rudolf-Breitscheid-Str. 187, 14482 Potsdam Building: G, Floor: 2nd.

Benjamin Bergner
E: benjamin.bergner@hpi.de
T: 0331/5509-4823

Suparno Datta
E: suparno.datta@hpi.de
T: 0331/5509-4817

Dr.-Ing. Matthieu-P. Schapranow
E: schapranow@hpi.de
T: 0331/5509-1331

Prof. Dr. Erwin Böttinger
E: erwin.boettinger@hpi.de
T: 0331/5509-163