Predicting knee osteoarthritis severity: comparative modeling based on patient's data and plain X-ray images

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Abstract

Knee osteoarthritis (KOA) is a disease that impairs knee function and causes pain. A radiologist reviews knee X-ray images and grades the severity level of the impairments according to the Kellgren and Lawrence grading scheme; a five-point ordinal scale (0–4). In this study, we used Elastic Net (EN) and Random Forests (RF) to build predictive models using patient assessment data (i.e. signs and symptoms of both knees and medication use) and a convolution neural network (CNN) trained using X-ray images only. Linear mixed effect models (LMM) were used to model the within subject correlation between the two knees. The root mean squared error for the CNN, EN, and RF models was 0.77, 0.97 and 0.94 respectively. The LMM shows similar overall prediction accuracy as the EN regression but correctly accounted for the hierarchical structure of the data resulting in more reliable inference. Useful explanatory variables were identified that could be used for patient monitoring before X-ray imaging. Our analyses suggest that the models trained for predicting the KOA severity levels achieve comparable results when modeling X-ray images and patient data. The subjectivity in the KL grade is still a primary concern.

Biography

Mr. Abedin is a PhD candidate at The Insight Centre for Data Analytics under National University of Ireland Galway (Currently recognized as Data Science Institute at NUI Galway). His research work is focused on quantitative analysis in sports in a partnership project with ORRECO; an Irish start-up company that provides evidence-based advice to individual athletes through analyzing blood biomarker and GPS data. He is developing a statistical algorithm that will help ORRECO to provide individualized advice about training need of athletes based on their own blood profile and GPS records. Specifically, the statistical algorithm will identify atypical players based on their blood profile and GPS data and generating alert to prevent probable injuries. Previously he worked as a senior statistician at an international public health research organization (icddr,b) based in Bangladesh where he lead a team of statisticians. According to Google Scholar his H-index is 12.

Publication

1. Modern R Programming Cookbook: Recipes to simplify your statistical applications, Jaynal Abedin
2. Data Manipulation with R - Second Edition, Jaynal Abedin, Kishor Kumar Das