18BCE1170 – Sibi akkash

**CSE3506 – DA3**

**Literature survey**

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**Surface Type Classification for Autonomous Robot Indoor Navigation**, Francesco Lomio , Erjon Skenderi, Damoon Mohamadi, Jussi Collin, Reza Ghabcheloo and Heikki Huttunen Tampere University, Finland. <https://arxiv.org/pdf/1905.00252.pdf>

XGBoost model, a state of the art implementation of the Gradient Boosting algorithm was used. It allows for faster computation and parallelisation, compared to normal boosting algorithms. They trained a tree based XGBoost model, with 1000 estimators and a learning rate of 0.01.

Fast Fourier transform was used for its ability to simplify complex repetitive signals, highlighting their key components. The second model was a fully convolutional neural network (FCN). This CNN has no pooling later, so the time series remains the same length throughout the convolution. After the convolutions, the features were passed to a global average pooling (GAP) layer. The GAP layer allows the feature maps of the convolutional layers to be recognised as category confidence maps.

The last model was a residual network (ResNet) composed by 11 layers, of which 9 are convolutional. The ResNet consists of 3 residual blocks, each composed of three 1-D convolutional layers, and their output is added to input of the residual block. The last residual block, similar to the FCN, is followed by a GAP layer and a softmax.

The deep learning models achieved an accuracy of over 60%, and an AUC of over 90%. The best performing combination of all 3 models had an accuracy of 68.21% and an AUC of over 91.98%

**Floor Surface Classification with Robot IMU Sensors Data,** Jiang Yueyu, Zhou Weiwei, Zhang Song, Gao Shang, UC San Diego. <http://noiselab.ucsd.edu/ECE228_2019/Reports/Report14.pdf>

They have used KNN, Logistic regression and random forest for modelling the data. They achieved an accuracy of 80.15% on the test dataset. They’ve used statistical features and advanced features like Fourier transform, wave length, norm entropy etc… They’ve used KNN as a base model to compare the other models.

Cross validation was used for the training. After tuning, the no of neighbours (k) was set as 50. With k = 50, 49.26% multi-class accuracy was achieved. For logistic regression they set k as 100 and c = 1.0. They achieved 60.25% accuracy with logistic regression. For random forest, the top 5 features were found to be yaw\_absolute\_max, yaw\_absolute\_min, yaw\_norm\_entropy, yaw\_mean\_absolute and yaw\_square\_root\_amplitude. The yaw orientation was the most important feature. They achieved 72% accuracy with random forest, on the test set.

For the CNN, they first converted the orientation from quaternion to euler format, which reduces the no of parameters from 10 to 9. Each sequence had a shape of 128 x 9. Fourier transformation was applied on the 3 angular velocity and 3 acceleration channels. To avoid overfitting, dropout was applied on each linear layer with ratio 0.5. They observed 80.15% accuracy with the CNN on the test set. They observed that KNN has highly vulnerable to noise in the dataset. Most of the models showed overfitting. There is high class imbalance.