Detecting sitting postures of aircaft passengers

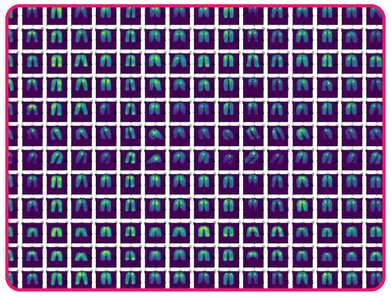
Pressure sensors could be used to determine the aircraft passenger posture or change in posture, which could indicate passengers' comfort. In this paper pressure sensors underneath the foam were used to detect the passenger posture. Additionally, an attempt was made to find the minimal number and positions of sensors that are needed to detect the posture. The pressure profiles of 12 sitting postures were collected of 33 subjects both at the top and the bottom of 3 different cushions, respectively. The experiment lasted 12 minutes for each cushion and it was tested in a static situation. Analysing the data indicated that it was possible to detect 7 types of postures with 15 sensors underneath of 3 types of cushions with an accuracy of 99.0%, which was higher than using the same amount of sensors on the top of the cushion. It was concluded that accurately detecting passenger posture using the sensors underneath the foam was possible. Further studies are needed with longer exposure time and in real flight conditions.

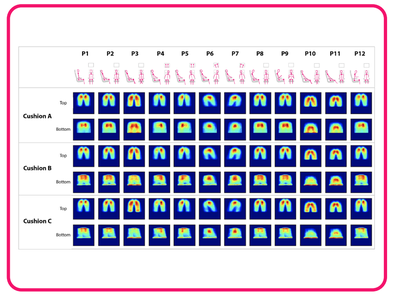
The purpose of this research is to study the relationship between different postures and support force sensed by pressure sensors both on the seat pan and under the foam. This study also focuses on whether the pressure distribution underneath the foam layer on the seat is informative enough to recognise common sitting postures of aircraft passengers and how to optimise the position of the pressure sensors to capture sitting posture changes in real time context with a minimum amount of sensors.

The research question is: Can sensors under the cushion detect sitting postures in an aircraft seat and if so, what is the minimum number of sensors and where should these be located?

Experiment setup

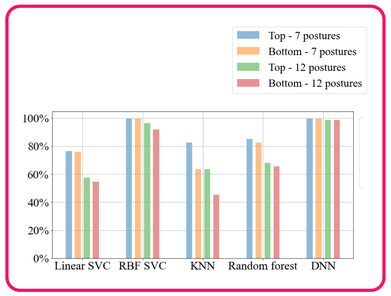
The Recaro BL3520 economy class passenger seat were used. Attached to the Recaro seats frame, a seat pan made of medium-density fibreboard (MDF) was created. Then two pressure mats and foams were placed followed the steps shown in the image.

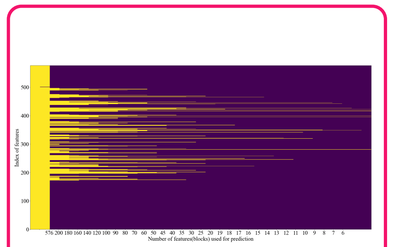




Data collection

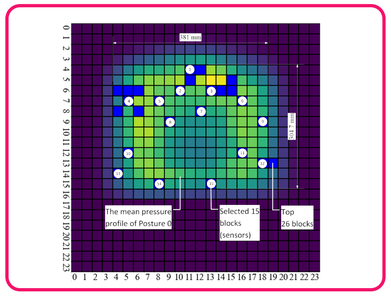
Pressure profiles were collected of 12 common sitting postures of aircraft passengers on three different types of cushions by using two Xsensor pressure mats, which were placed on the top and bottom of the foam.

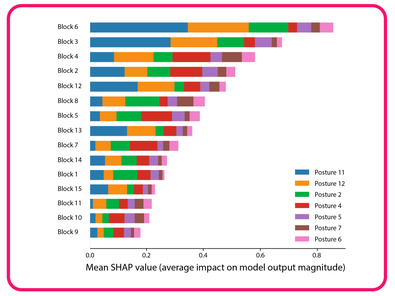




Data analysis

After data augmentation, different classifiers were applied and the DNN outperformed than others. Together with the SHAP value, the minimal amount and position of the FSR pressure sensors were explored.





The results

Based on the DNN classidier and the SHAP value, we selected 15 out of 256 sensor positions underneath the foam that contribute most to the prediction of 7 postures, with an accuracy of 99.0%.

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Design a smart cushion for civil aircraft seats
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Integrated Product Design

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