CS 464 PROPOSAL REPORT

- **Project Title :** Making the Models of Composite Armor Systems by Using Reinforcement Learning
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- **Description of The Data:** Our data consists of a big canvas whose shape could be a square or a rectangle. That canvas will represent the part of armored vehicle. We will have hexagonal and square ceramic tiles which are smaller than our canvas. The tiles can be cut in half with equal size either diagonally or from the vertices.
- **Our Aim:** "CPS Technologies (CPS) has developed a technology for improving the toughness of ceramic tiles in composite armor systems by selectively reinforcing them with metal and metal matrix composites (MMC) and then packaging them in a hermetic layer of high-pressure cast aluminum. Armor integrators can translate this improvement into more consistent ballistic performance, reduced need for gap-fillers, and improved ballistic performance near tile edges."[1] Our aim is to minimize the usage of ceramic tiles, so that we can apply the tiles to increase the toughness of an armored vehicle and to minimize the area of the canvas after the placement occurs by finding an optimal model.
- **Our Plan:** We will not use the pre-formed models of the canvas with specific length. Because, the number of pre-formed models, which is already furnished by hexagons and squares, is very limited and it will take more time to determine the junction points between hexagonal and square shapes. However, we will create a model, by using negative reinforcement learning. The agent will start to add bunch of shapes to the canvas and we will calculate the area of gaps and the number of shapes used. After that, we penalize excessive usage of shapes and total area of gaps. We will prioritize total area of gaps; therefore, we will give mentioned situation higher penalty term. Secondly, we will quantize the length of canvas and shapes, cutting and placement will be quantized as well. The quantization is made because of the performance issues, if we will use the floating point numbers to describe the lengths of shapes, it could take longer time to achieve the result, the speed of training will be diminished, the memory will be limited; therefore, we cannot store all of the floating point values, and at the end, we will have an irreducible error, which can be compansated using one more shape.
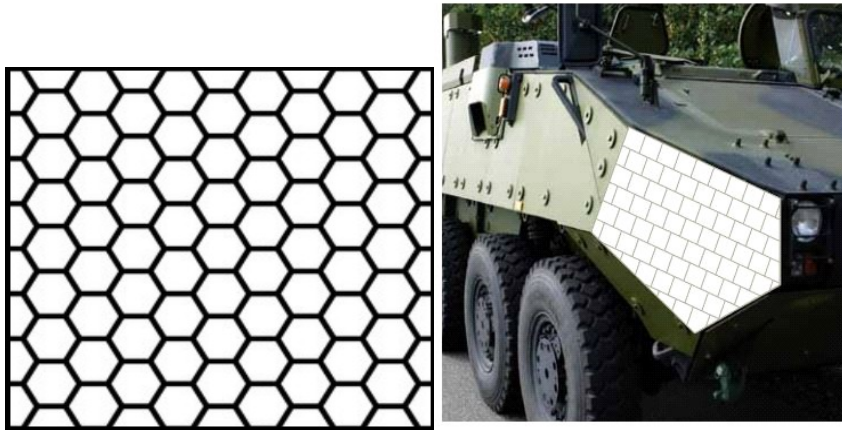
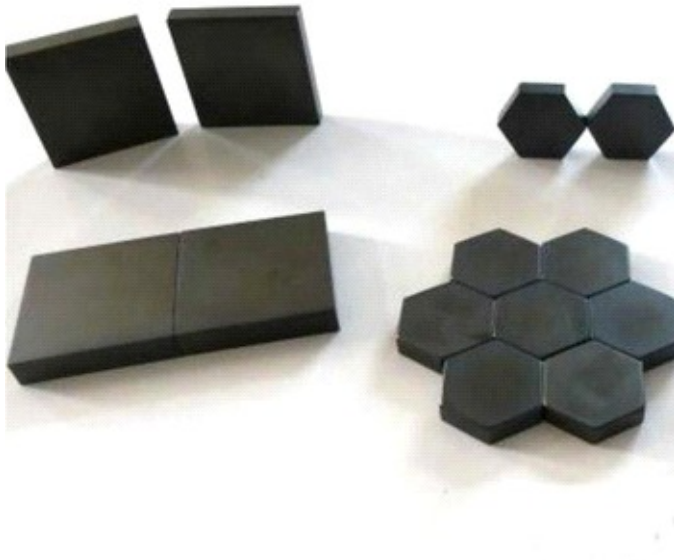Figure 3-4: Hexagonal and square ceramic tiles packages[2][3]

Figure 1: Square and hexagonal ceramic tiles[1]

- **References:**
[1] B. Wang, "Aluminum encapsulated ceramic tiles for hybrid armor,"
1761eac3b1967fa6e4cafb6af110abcc-1, 07-Apr-2017. [Online]. Available:
https://www.nextbigfuture.com/2011/01/aluminum-encapsulated-ceramic-tiles-for.html.
[Accessed: 29-Oct-2019].
[2] Drawn by Ege Tinaz. [Accessed: 29-Oct-2019].
[3] "Technical Ceramics from The Ceramic Experts," Technical Ceramics. [Online].
Available: https://www.ceramtec.com/ceramic-materials/. [Accessed: 30-Oct-2019].