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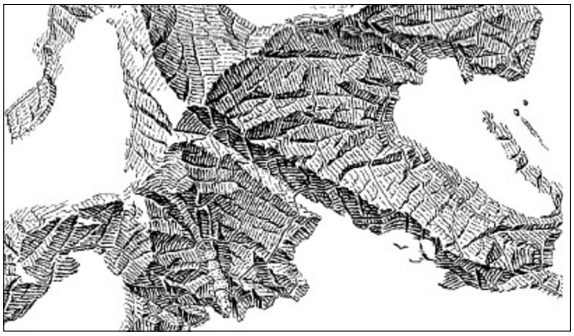
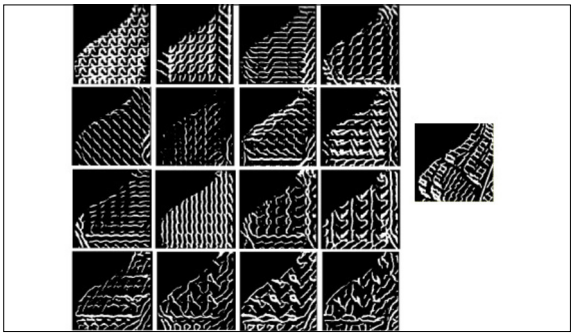
Subject Area	Software and Systems

Automated Swiss-style Rock Drawing using Deep Learning



Example for rock depiction in the National Map of Switzerland 1:25'000.

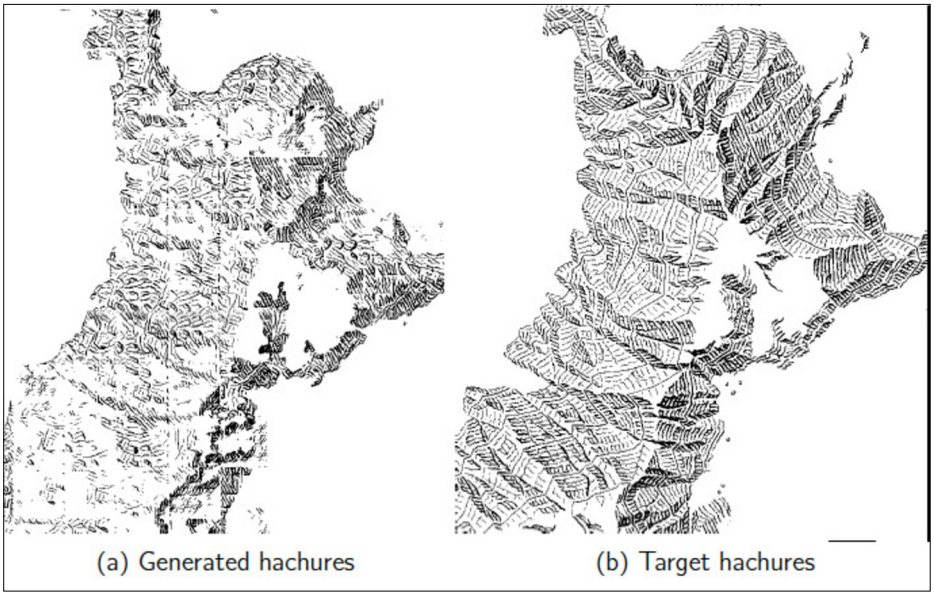


Generated hachures over time, read from top left to bottom right.

Introduction: Rock depiction in cartography is still done manually by human experts. This craft has been perfected by the Swiss National Maps which have a worldwide reputation. Combined with the shaded relief, rock hachures give the map reader a good impression of the shape, the steepness and the nature of rock surfaces.

Objective: The goal of this thesis was to generate rock hachures by using a deep learning approach. Through machine learning a computer programm has been trained to perform a task without being explicitly programmed what to do. Specifically, the program tried to find a mapping function by looking at examples of input-target pairs. Given the requirements of this thesis a conditional adversarial network has been selected, called 'pix2pix' (University of California), which reported good performance on image-to-image translation tasks. Next, input-target pairs have been generated from elevation spatial data, a rock mask layer and rock hachures. These samples have been used to train and validate a deep neural network. Finally the trained network has been used to generate rock hachures, and the result has been visualized.

Result: The achieved results unfortunately have been dissatisfying. It was not possible to find an effective machine learning model. Even after preprocessing and after testing different input representations and network loss values, the performance of the program did not significantly improve. Figure 3 shows the generated rock hachures (a), alongside the hachures of the National Map of Switzerland 1:25'000 (b). Even though the machine learning model was able to learn some basic visual structures, the hachures look like being almost randomly placed. In addition other issues remain to be resolved like the artefacts of the sample borders which currently remain visible. To conclude, the goals of this thesis could not be reached so far, as it may happen in complex machine learning challenges. But it is believed that it's worthwhile to continue research based on this work.



Generated rock hachures compared with target rock hachures.