



Initial Experiments with Image Alignment in Brazil's Customs

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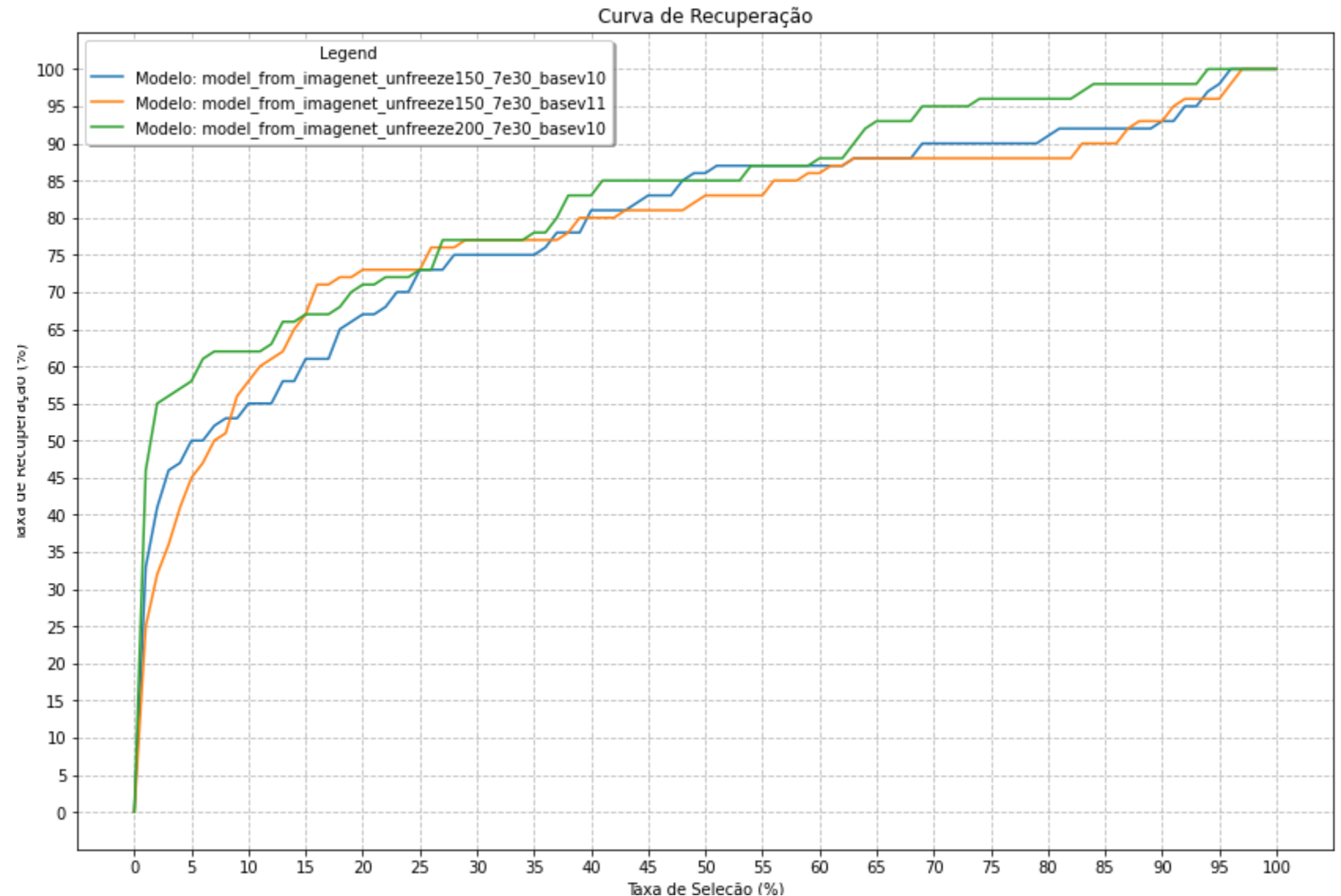
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Target Problems

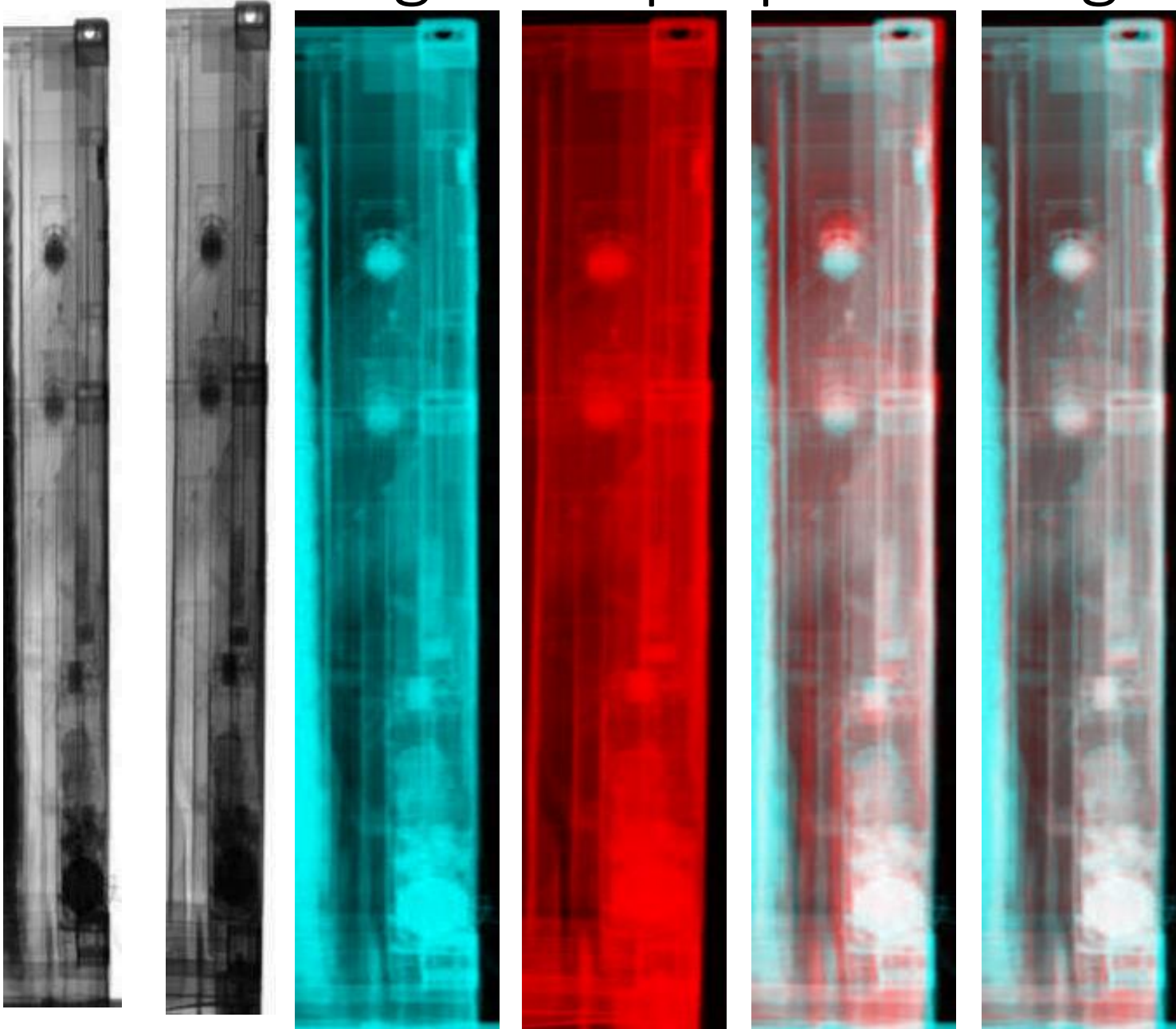
- Problems where two images of the same object in two different moments are available
 - Detecting relevant changes
- Sources of irrelevant differences
 - intensity of the x-ray engines,
 - angle of the x-ray beam
 - trucks accelerate and decelerate while moving through scanners
 - the cargo itself moves inside the container.
 - Image alignment should compensate for all that.
- Rip-on / Rip-off
 - Cargoes in customs transit within Brazil
 - Image exchanges with other countries
- Concealed cargo in the structure of reefer containers
 - The same containers come and go many times through Brazil's customs
 - The cargo changes, but the structure of the reefer is the same

Drugs in Reefers

- Currently we only use one image, the current one
 - There is no alignment
- Best model
 - Deep neural net
 - Implemented in Tensorflow
 - Based EfficientnetB4
 - Pre-trained with the imagenet dataset
 - 200 layers unfreezed
- Dataset with very few positive cases (less than 20)
- A national API for image transmission is coming



Prior images for preprocessing

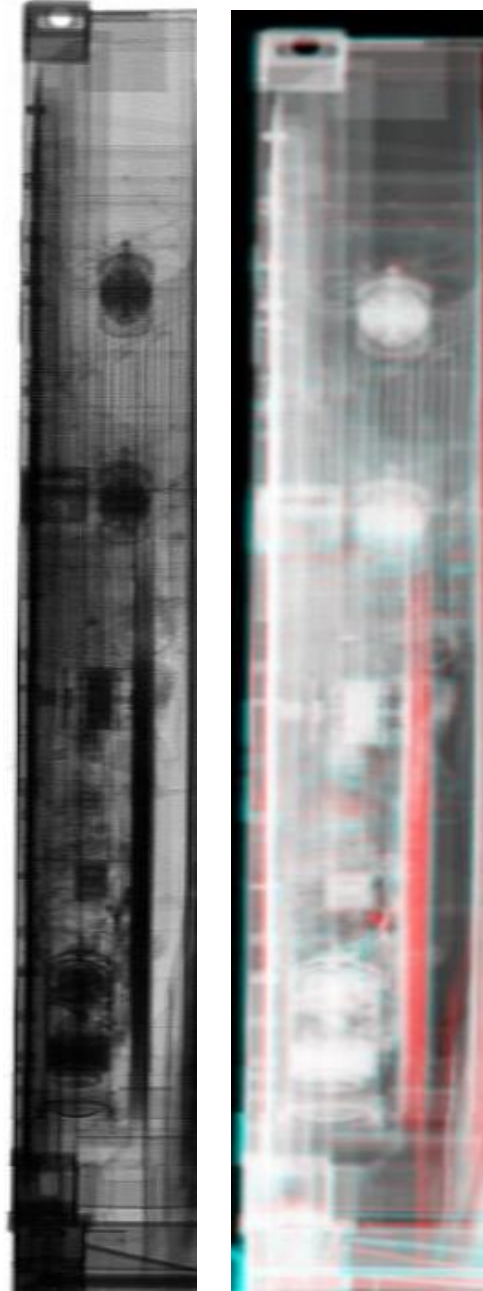


- First tried image hashing
 - Focused on whole images not specific parts
- Moved to alignment algorithms
 - Kornia library:
 - LoFTR, Image registration
- Best results using our own algorithm
 - Optimizes a warp transformation
 - Warps are frequently used for fun

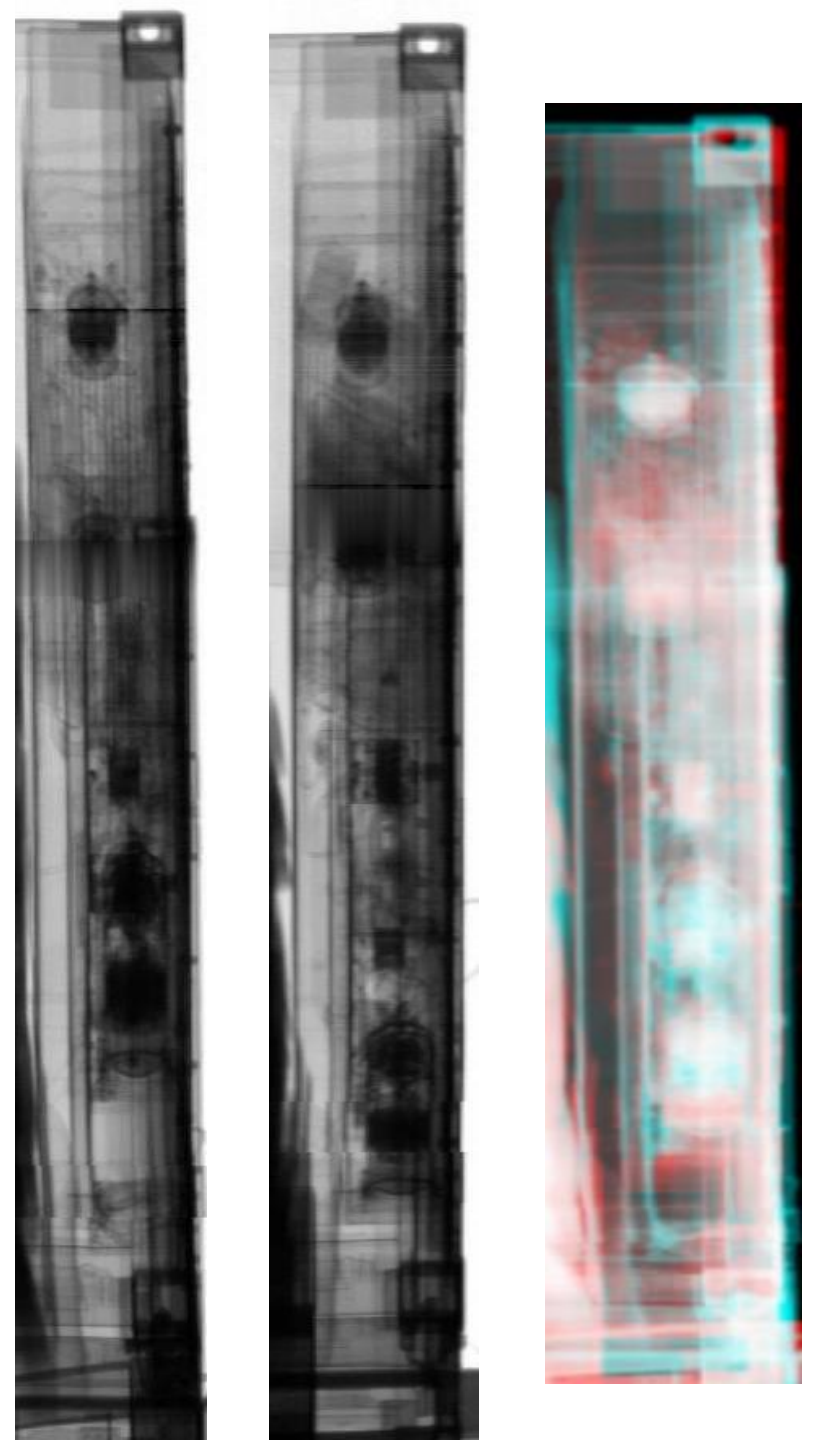


Plans for reefers

- Goal: train the EfficientNetB4 using the combined images
- We expect gains
- In the majority of tested cases drugs became red
- Red is a simpler pattern than a shape



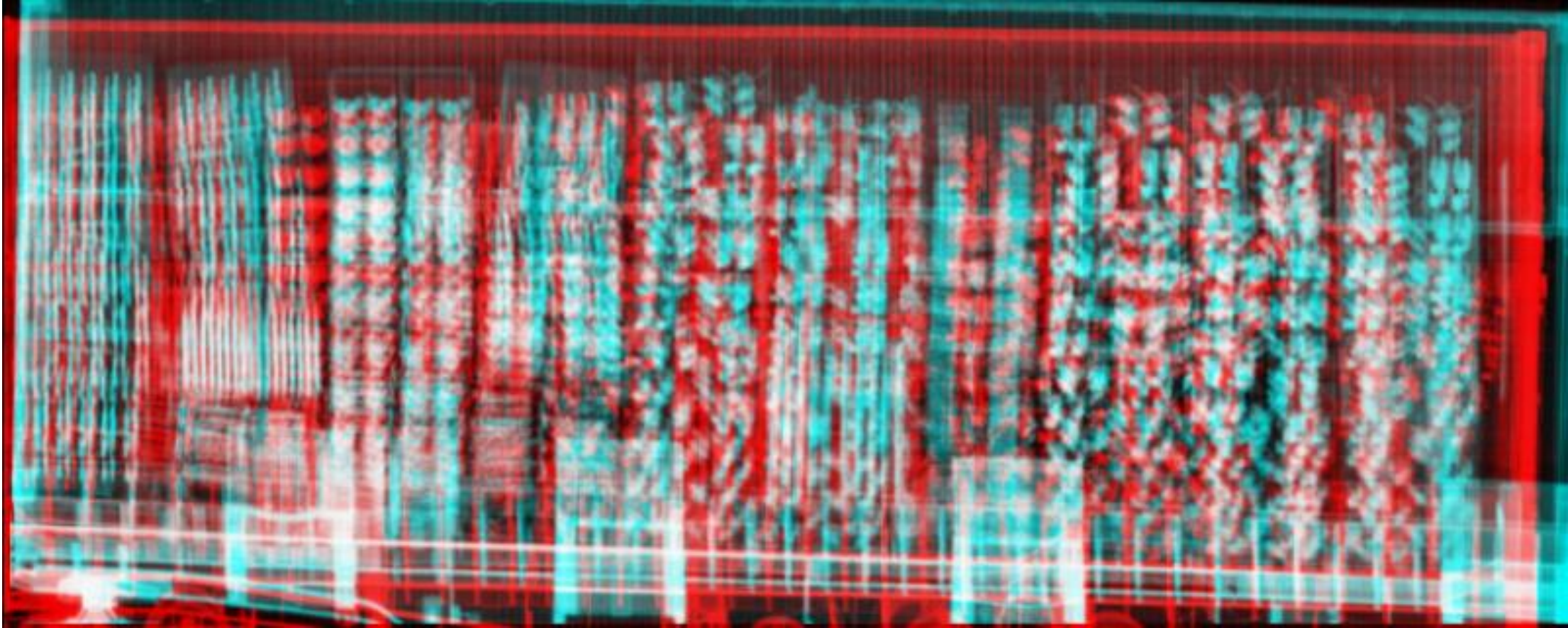
- Sometimes alignment does not lead to clear patterns



Alignment of Cargo Images

- Still too slow, but we have plans to optimize it.
- Problems with local optima
 - We used a grid to choose better starting point
- Clipping differences
 - We needed a specific layer to compensate for them.
- Still to do
 - Change the cost function from comparing pixels to comparing features
 - Generate suitable features
 - Make the model more flexible
 - Just increasing flexibility destroys relevant differences

Superposition of Cargo Image



Alignment of Cargo Image

