The DNAMIC project, part of the European Pathfinder program for DNA-based digital data storage, aims to develop an autonomous, end-to-end DNA data storage solution based on a microfactory. Long-term data archiving is our main use case, and we will use the OAIS-compliant OLOS system (Burgi et al., 2022) (olos.swiss) as the interface with the microfactory for this purpose. This initiative brings together scientists from academia and industry across Europe. At the University of Geneva, our team is designing a codec that encodes and decodes binary data in DNA while integrating it into the OLOS framework. Our initial experiments using silicon-based synthesis led us to explore alternative synthesis solutions. Photolithographic synthesis, for instance, provides greater scalability for producing volumes in the range of gigabyte and beyond, potentially at lower cost (Gimpel et al., 2024). However, this approach poses challenges reminiscent of those encountered in earlier methods. Notably, the synthesized oligonucleotides are smaller and have a much higher error rate than those available from providers using silicon-based synthesis (Antkowiak et al., 2020). Homogeneity is also a concern, as variations in error rates depending on the position of the synthesis on the photolithographic chip can lead to uneven prevalence of certain strands. Contrary to the trend of developing codecs capable of easier and faster decoding thanks to low-error synthesis, we need to find algorithms that are more resilient to synthesis (and sequencing) errors.

Our solution consists of proceeding according to a multistep correction system: the encoding scheme divides the files into separate logical blocks, allowing us to decode them independently with the appropriate level of precision. For the clustering stage, we use a custom algorithm based on k-mers and a state-of-the-art approximate nearest-neighbor method, which we implemented with Nvidia's cuVS for greater efficiency. To allow comparisons between silicon-based synthesis and photolithographic synthesis, the results on data showing different error profiles will be presented.

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