



DeFIS - Detection pipeline with k-mers analysis to identify species

Sarah Maman, Gaston Rognon, Chloé Bellanger, Léonard Ransan, Patrick Jacques, Christophe Klopp, Régis Debruyne, Brice Ephrem, Myriam Sternberg, Aurélie Manicki, et al.

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DEFIS – DETECTION PIPELINE WITH K-MERS ANALYSIS TO IDENTIFY SPECIES.

DeFIS « Detection of Fauna and flora: Identification of Species ».

CONTEXT

- DNA highly degraded.
 - Quick identification focuses on repeated zones.
 - Conventional mapping tools inadequate.
- For:
- Modern and ancient DNA.
 - Tested on several species and on genomes of different sizes.

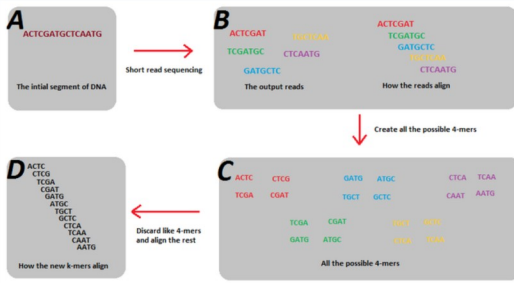
DETECTION PIPELINE PRINCE

- Identifies species by comparing k-mers dictionaries between:
- a chosen reference genome,
 - and the studied samples.

K-MERS DEFINITION

A k-mer is a subsequence of length k nucleotides extracted from a longer sequence.

Source: <https://en.wikipedia.org/wiki/K-mer>



PIPELINE STEPS & RESULTS

This pipeline includes :

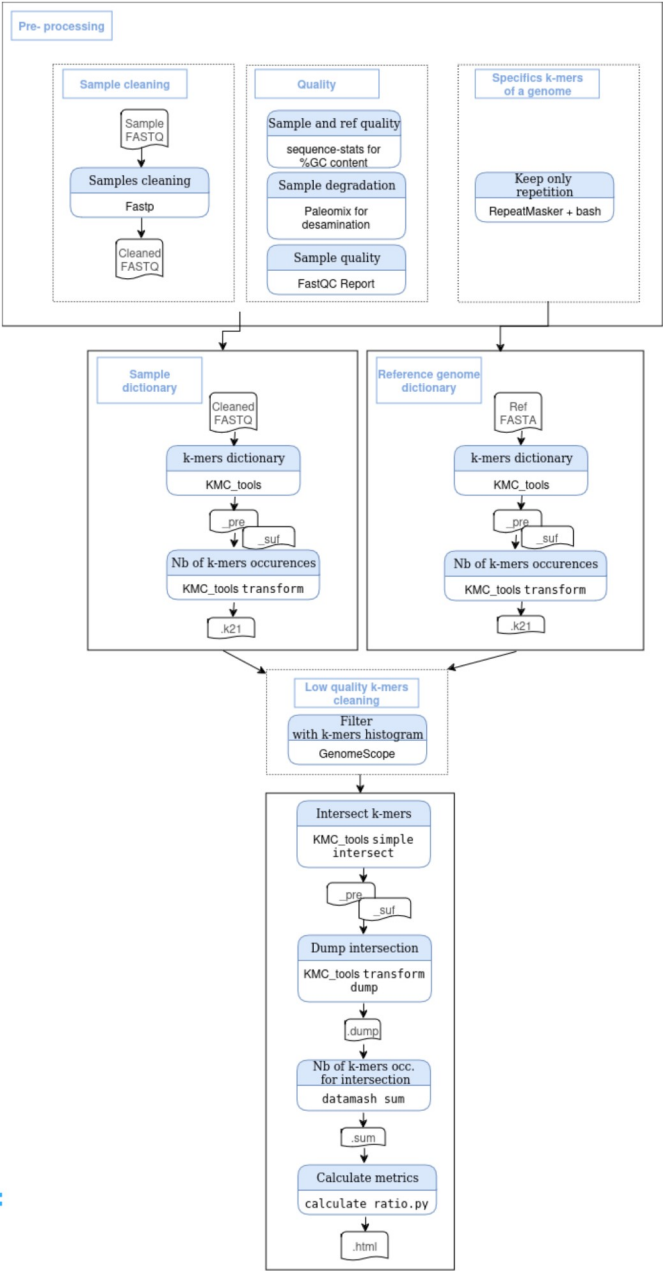
- Pre-process to clean and analyse quality as %GC content or degradation.
- KMC_tools [1] to generate k-mers dictionaries for reference genome(s) and sample(s).
- Intersect these dictionaries.
- Calculate metrics as Jaccard similarity/dissimilarity indices [2], ratio.
- Determine the closest species.
- HTML report to display results.

This pipeline is being improved to save processing time and computing resources:

- Study the works of Camila Duitama (akmerbroom & decom) [3] [4]
- To minimize dictionaries sizes: filter out low-quality k-mers, erroneous k-mers.
- To focus on repeated zone:
 - Specific of a genome.
 - Provide an indication of resistance to DNA degradation.
 - Provide some precomputed sets of k-mers.

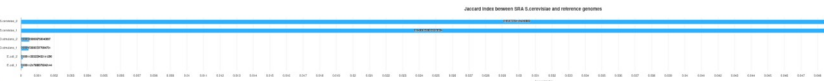
This potential impact of repeated zones is being studied by comparing small dictionaries, representing those most commonly found within a species.

This pipeline has already been employed with success to taxonomically identify fish archaeological remains, the oldest ones dating from the paleolithic period [5].



RESULTS TABLE

Sample	Intersect Species	Nb k-mers Intersect	Nb k-mers Sample	Nb k-mers Ref	Ratio
Sample1	Species1	1000000	1000000	1000000	1.0
Sample2	Species2	500000	1000000	1000000	0.5
Sample3	Species3	250000	1000000	1000000	0.25
Sample4	Species4	125000	1000000	1000000	0.125
Sample5	Species5	62500	1000000	1000000	0.0625



Sarah MAMAN¹, Gaston ROGNON², Chloé BELLANGER², Léonard RANSAN², Patrick JACQUES³, Christophe KLOPP⁴, Régis DEBRUYNE⁵, Brice EPHREM⁶, Myriam STERNBERG⁷, Aurélie MANICKI³, Joëlle CHAT³, Philippe BEAREZ⁵, Natacha NIKOLIC^{3,8}
¹ Sigenae, GenPhySE, Université de Toulouse, INRAE, ENVT, 24 chemin de Borde Rouge, F-31326, Castanet Tolosan, France. - ² Université Paul Sabatier 118 route de Narbonne, 31062 Toulouse, France. - ³ UMR INRAE-UPPA ECOBIO, 64310 Saint Pée sur Nivelle, FRANCE. - ⁴ Sigenae, MIAT, INRAE, 24 chemin de Borde Rouge, F-31326, Castanet Tolosan, France. - ⁵ CNRS/MNHN, UMR 7209, Paris, France. - ⁶ CNRS, UMR 6566, CReAAH, Rennes, France. - ⁷ CNRS, UMR 7299, Aix-en-Provence, France. - ⁸ CRBE, Aquaeo, Université de Toulouse, France
Corresponding Author: sarah.maman@inrae.fr <https://forgemia.inra.fr/sarah.maman-haddad/DeFIS/>

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