Human Fibroblast IMR90 Hi-C Data (Dixon et al.)

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1 Introduction

The Hi-C technic was first introduced by Lieberman-Aiden et al. [2009]. In the continuity with 3C, 4C and 5C technics, the goal of the Hi-C is to simultaneoulsy detect all chromosomal contacts in a single experiment. All this technics aim at measuring the population-averaged frequency at which two genomic loci physically interact in three-dimensional space. In Hi-C, after a first crosslink and digestion, all genomic fragments are labeled with a biotinylated nucleotide before ligation. These junctions can then be purified efficiently by streptavidin-coated magnetic beads, and finaly sequenced using a standard Illumina paired-end protocol.
The data available in this package were published by Dixon et al. [2012] and downloaded from the GEO website (GSE35156, sample GSM862724). This publication is one of the key paper in the field for two main reasons: i) it was the first time than Hi-C data were generated at such resolution (up to 20kb), ii) this resolution highlighted a new short range structure defined as topological domains (TADs), with high frequencies of intra-domain chromatin interactions but infrequent inter-domain chromatin interactions (Nora et al. [2012]).

If you use *HiCDataHumanIMR90*, please cite:

- Servant N (2014). HiCDataHumanIMR90: Human Fibroblast IMR90 HiC data from Dixon et al. 2012. R package version 1.1.0.
- Dixon JR, Selvaraj S, Yue F, Kim A et al. (2012) Topological domains in mammalian genomes identified by analysis of chromatin interactions. Nature 485(7398):376-80.

2 Hi-C Data

The `hic_imr90_40` object is a *HTClist* object (see the *HiTC* package for more information (Servant et al. [2012])). It contains the complete genome-wide HiC data, with all inter and intrachromosomic contact maps at a resolution of 40kb.

```
> require(HiCDataHumanIMR90)
> require(HiTC)
> data(Dixon2012_IMR90)
> ## Show data
> show(hic_imr90_40)
```

```
HTClist object of length 325
25 intra / 300 inter-chromosomal maps
```

```
> ## Is my data complete (i.e. composed of intra + inter chromosomal maps)
> isComplete(hic_imr90_40)
```

```
[1] TRUE
```

```
> ## Note that a complete object is not necessarily pairwise
> ## (is both chr1-chr2 and chr2-chr1 stored ?)
> isPairwise(hic_imr90_40)
```

```
[1] FALSE
```

```
> ## Which chromosomes ?
> seqlevels(hic_imr90_40)
```

```
 [1] "chr1"  "chr2"  "chr3"  "chr4"  "chr5"  "chr6"  "chr7"  "chr8"  "chr9"  "chr10"
[11] "chr11" "chr12" "chr13" "chr14" "chr15" "chr16" "chr17" "chr18" "chr19" "chr20"
[21] "chr21" "chr22" "chrX"  "chrY"  "chrM"
```

```
> ## Details about a given map
> detail(hic_imr90_40$chrXchrX)
```

```
HTC object
Focus on genomic region [chrX:1-155270560]
CIS Interaction Map
Matrix of Interaction data: [3882-3882]
Binned data - window size = 40000
3882 genome intervals
Total Reads =  15349610
Number of Interactions =  3362484
Median Frequency =  1
Sparsity =  0.112
```

```
> ## Descriptive statistics
> head(summary(hic_imr90_40))
```

```
         seq1 seq2  nbreads nbinteraction averagefreq medfreq sparsity
chr1chr1 chr1 chr1 25914788       4524734      5.7274       1   0.8835
chr2chr1 chr2 chr1   504332        497291      1.0142       1   0.9869
chr3chr1 chr3 chr1   440865        434917      1.0137       1   0.9859
chr4chr1 chr4 chr1   456924        450005      1.0154       1   0.9849
chr5chr1 chr5 chr1   399067        393926      1.0131       1    0.986
chr6chr1 chr6 chr1   382580        377654       1.013       1   0.9858
```

3 Topological Domains

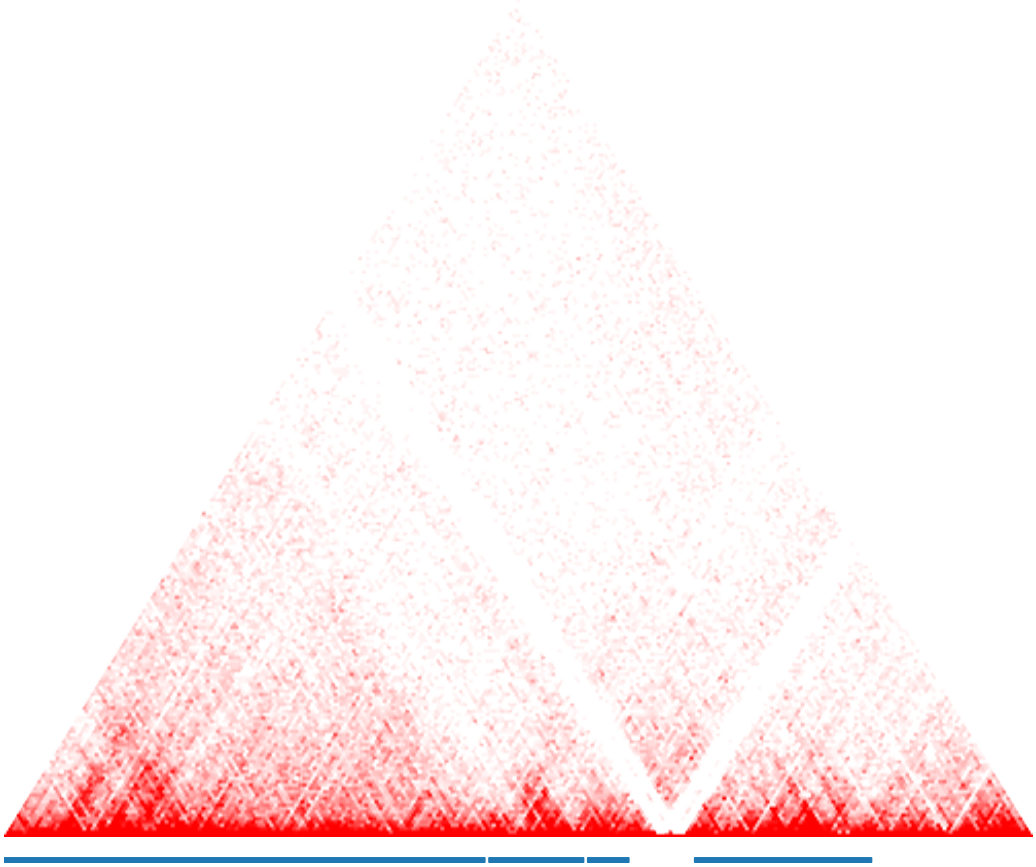
The tads_imr90 object is a *GRanges* object with a all TADs detected from this Hi-C data.

```
> show(tads_imr90)
```

```
GRanges object with 2338 ranges and 0 metadata columns:
          seqnames                ranges strand
             <Rle>             <IRanges>  <Rle>
     TAD-1     chr1     [ 770138, 1290137]      *
     TAD-2     chr1     [1290138, 1850140]      *
     TAD-3     chr1     [1850141, 2330140]      *
     TAD-4     chr1     [2330141, 3610140]      *
     TAD-5     chr1     [3770141, 6077413]      *
       ...      ...                    ...    ...
```

```
  TAD-2334     chrX [146992309, 148552096]      *
  TAD-2335     chrX [148592096, 149929342]      *
  TAD-2336     chrX [149929343, 151969344]      *
  TAD-2337     chrX [152089345, 152746806]      *
  TAD-2338     chrX [152786807, 154946806]      *
  -------
  seqinfo: 23 sequences from an unspecified genome; no seqlengths
```

```
> ## Extract region
> regx <- extractRegion(hic_imr90_40$chrXchrX,
+                       chr="chrX", from=95000000, to=105000000)
> ## Plot Hi-C data with TADs
> plot(regx, tracks=list(tads_imr90), maxrange=20)
```



Package versions

This vignette was generated using the following package versions:

- R version 3.1.2 (2014-10-31), x86_64-unknown-linux-gnu
- Base packages: base, datasets, grDevices, graphics, methods, parallel, stats, stats4, utils
- Other packages: BiocGenerics 0.12.1, GenomeInfoDb 1.2.3, GenomicRanges 1.18.3, HiCDataHumanIMR90 1.0.0, HiTC 1.10.0, IRanges 2.0.0, S4Vectors 0.4.0, XVector 0.6.0
- Loaded via a namespace (and not attached): BBmisc 1.8, BatchJobs 1.5, BiocParallel 1.0.0, BiocStyle 1.4.1, Biostrings 2.34.0, DBI 0.3.1, GenomicAlignments 1.2.1, Matrix 1.1-4, RColorBrewer 1.0-5, RCurl 1.95-4.4, RSQLite 1.0.0, Rsamtools 1.18.2, XML 3.98-1.1, base64enc 0.1-2, bitops 1.0-6, brew 1.0-6, checkmate 1.5.0, codetools 0.2-9, digest 0.6.4, fail 1.2, foreach 1.4.2, grid 3.1.2, iterators 1.0.7, lattice 0.20-29, rtracklayer 1.26.2, sendmailR 1.2-1, stringr 0.6.2, tools 3.1.2, zlibbioc 1.12.0

References

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