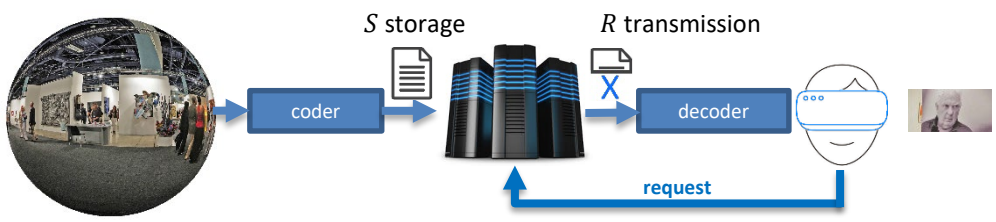
MOVE: Mature Omnidirectional Video Exploration

TEAMS
- Inria
- IMT Atlantique

External partners: EPFL.

Random Access to subsets of data in the compressed domain

MOVE is the follow up of the **interCom** project that developed **compression** techniques allowing **random access** to large databases in the **compressed domain**.

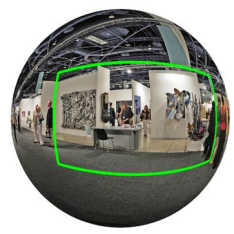


- **random access:** The dataset is stored on a server. Users request a subset of the data. Such a request for a subset of the data is indeed **random**, since the choice of the subset is user-dependent.
- in the **compressed domain:** upon request, the server can only perform low complexity operations (for instance no decompression/compression).

Goal: low storage at server (S), low transmission cost (R)

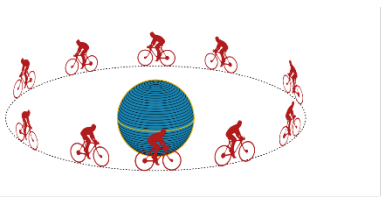
Achievements of the interCom project
1. Problem formulation
2. Derivation of compression bounds
3. Practical implementation

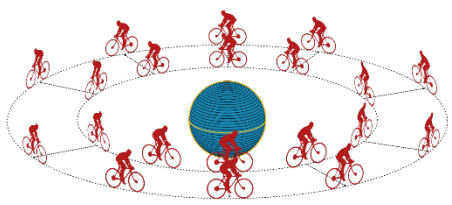
Example: of data processed omnidirectional images

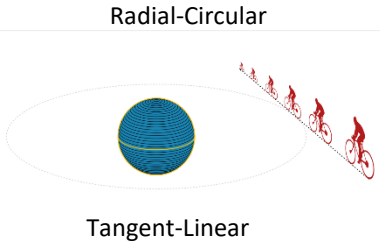


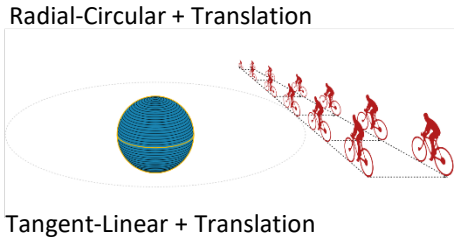
Generalization: from image to video

➢ **Motion model**


Radial-Circular

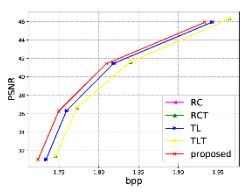

Radial-Circular + Translation

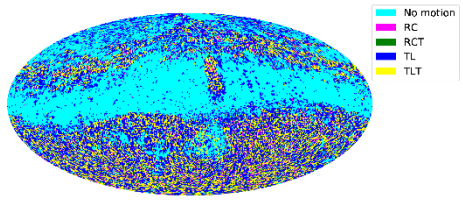

Tangent-Linear


Tangent-Linear + Translation

➢ **Motion model selection** based on Rate Distorsion optimization [1]

RC(T) = Radial-Circular (Translation) , TL(T) = Tangent-Linear (Translation)

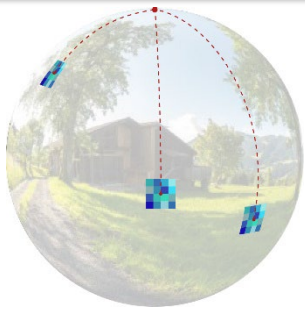




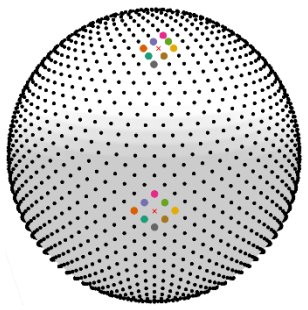
	no motion	RC	RCT	TL	TLT
Low bitrate	82.01 %	0.06 %	0.04 %	17.45 %	0.44 %
High bitrate	43.01 %	3.4 %	3.12 %	32.99 %	17.48 %

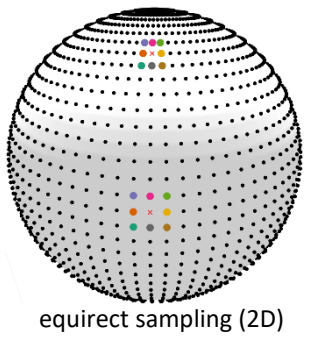
On-the-sphere processing for 360 data

➢ Transforms, predictions [2]
➢ **CNNs [3]**
- convolution
  - **coherent**: rotation equivariant
  - **expressive**: anisotropic filter
  - **low complexity**: linear in Nb pixels
- pooling/unpooling, stride



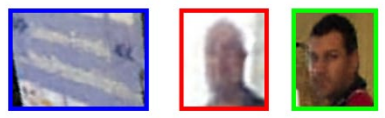
➢ coherent convolution (left) vs distorted support (right)


healpix sampling


equirect sampling (2D)

➢ application to compression:
preserve high frequency

Deepsphere (graphconv):



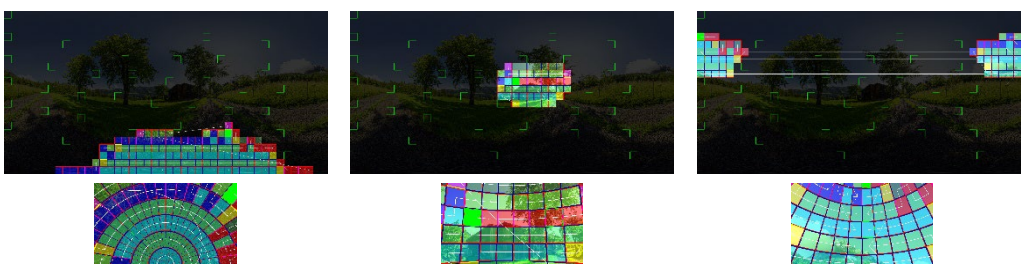
OSLO:

Transfer action

Support for the Inria grant (Technology Development Action)

➢ **Open-source coder**
Transfer the developed coder to research partners (industrial or academic)

➢ **Demonstrator**
Show the benefits of our approach on **real** videos watched by **real** users



Startup project: Anax

AI-powered 3D virtual tour solution

Outcome of MOVE for ANAX:
- 1 year **grant** from Inria Startup Studio (2 engineers)
- **award**: innovation i-PhD contest (BpiFrance)

[1] A. Marie, N. Mahmoudian-Bidgoli, T. Maugey, A. Roumy, Rate-distortion optimized motion estimation for on-the-sphere compression of 360 videos, ICASSP, 2021.
[2] N. Mahmoudian bidgoli, T. Maugey and A. Roumy. Intra-coding of 360-degree images on the sphere, Picture coding symposium (PCS), 2019.
N. Mahmoudian Bidgoli, R. Azevedo, T. Maugey, A. Roumy, P. Frossard, OSLO: On-the-Sphere Learning for Omnidirectional images and its application to 360-degree image compression, IEEE Trans on Image Processing, 2022.