



## Automatic detection of beating cilia with frequencies estimations

Élodie Puybareau, Hugues Talbot, Gabriel Pelle, Bruno Louis, Laurent Najman, André Coste

► **To cite this version:**

Élodie Puybareau, Hugues Talbot, Gabriel Pelle, Bruno Louis, Laurent Najman, et al.. Automatic detection of beating cilia with frequencies estimations. *Cilia* 2014, Nov 2014, Paris, France. 2015, <10.1186/2046-2530-4-S1-P85>. <hal-01332964>

**HAL Id: hal-01332964**

**<https://hal-upec-upem.archives-ouvertes.fr/hal-01332964>**

Submitted on 16 Jun 2016

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

# Automatic detection of beating cilia with frequencies estimations

Elodie Puybureau<sup>1</sup>, Hugues Talbot<sup>1</sup>, Gabriel Pelle<sup>2</sup>, Bruno Louis<sup>2</sup>,  
Laurent Najman<sup>1\*</sup>, André Coste<sup>2\*</sup>

Université Paris-Est

<sup>1</sup>Laboratoire d'Informatique Gaspard Monge , CNRS UMR8049

<sup>2</sup>Inserm UMR955 Mondor Institute of Biomedical Research, Cellular and Respiratory  
Biomechanics Laboratory

## 1 Objectives

Muco-ciliary clearance is the airway first mechanism of defence against environmental attacks such as micro-organisms or pollution. Cilia motility impairment can be either of genetic (primary ciliary dyskinesia) or acquired origin (environmental attacks), entailing chronic diseases. It is of interest for practitioners to evaluate cilia beating frequency easily, robustly and reliably. As yet, no fully automatized method is available.

## 2 Methods

Ciliated cells were sampled in patients by brushing nasal mucosa and cilia beating was recorded using high speed video microscopy. We first estimated and removed the sensor pattern. We then stabilized the sequence assuming rigid transforms. We retained only the moving parts of the sequence and, after deblurring, characterized and segmented the moving parts in several regions of interest. The frequency was estimated for each region.

## 3 Results

We output the processed sequence, a labeled mask of the various beating zones and a chart of the frequency observed in each region. Hence we obtained synchronization information between the different parts of the observed ciliated cells. An estimation of frequencies for each beating part is the final result.

## 4 Conclusion

With this new method, we propose a fully automatic estimation of cilia beating frequencies, which is able to deal with acquisition artifacts, such as sensor patterns, vibrations and noise, but also with the variety of frequencies we can observe on a single sample. We believe this may be a useful method for practitioners.

---

\*These authors contributed equally to this work