EUROPEAN SYNCHROTRON RADIATION FACILITY

INSTALLATION EUROPEENNE DE RAYONNEMENT SYNCHROTRON

Experiment Report Form

The double page inside this form is to be filled in by all users or groups of users who have had access to beam time for measurements at the ESRF.

Once completed, the report should be submitted electronically to the User Office via the User Portal:

https://wwws.esrf.fr/misapps/SMISWebClient/protected/welcome.do

Reports supporting requests for additional beam time

Reports can be submitted independently of new proposals – it is necessary simply to indicate the number of the report(s) supporting a new proposal on the proposal form.

The Review Committees reserve the right to reject new proposals from groups who have not reported on the use of beam time allocated previously.

Reports on experiments relating to long term projects

Proposers awarded beam time for a long term project are required to submit an interim report at the end of each year, irrespective of the number of shifts of beam time they have used.

Published papers

All users must give proper credit to ESRF staff members and proper mention to ESRF facilities which were essential for the results described in any ensuing publication. Further, they are obliged to send to the Joint ESRF/ ILL library the complete reference and the abstract of all papers appearing in print, and resulting from the use of the ESRF.

Should you wish to make more general comments on the experiment, please note them on the User Evaluation Form, and send both the Report and the Evaluation Form to the User Office.

Deadlines for submission of Experimental Reports

- 1st March for experiments carried out up until June of the previous year;
- 1st September for experiments carried out up until January of the same year.

Instructions for preparing your Report

- fill in a separate form for each project or series of measurements.
- type your report, in English.
- include the reference number of the proposal to which the report refers.
- make sure that the text, tables and figures fit into the space available.
- if your work is published or is in press, you may prefer to paste in the abstract, and add full reference details. If the abstract is in a language other than English, please include an English translation.

ESRF	**Experiment title:** Airway closure and oxygen reabsorption as causes of atelectasis during general anesthesia	**Experiment number:** MD-658
Beamline: ID 17	**Date of experiment:** from: 30 May 2012 to: 5 June 2012	**Date of report:** 28th August 2012
Shifts: 15	**Local contact(s):** Christian Nemoz	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

Sam Bayat *(Laboratoire Peritox EA, Universite de Picardie, France)

Joao Batista Borges* (Dept.Medical Sciences, Uppsala University, Sweden)

Savino Derosa*(Dept. Emergency and Organ Transplant, Università di Bari, Bari, Italy)

Göran Hedenstierna*(Dept.Medical Sciences, Uppsala University, Sweden)

Gaetano Perchiazzi* (Dept. Emergency and Organ Transplant, Università di Bari, Bari, Italy)

Report:

The authors performed a functional study using K-edge subtraction (KES) method followed by a second stage using FReLoN detector at 47 microns resolution. The experiments were performed in 11 New Zealand rabbits divided in two groups: 7 rabbits were studied with KES and 4 rabbits using FReLoN.

<u>*Low resolution and K-edge subtraction (KES) setting*</u>

All the animals were kept alive until the end of images acquisition, mechanically ventilated and exposed to both FiO_2 of 21% and 100%. First the rabbits were subjected to a procedure aimed at standardizing lung volume and diaphragm position in upright posture. After recruitment maneuvers, at each FiO_2 condition, two different PEEP values (12 and 0 cmH_2O) were applied. For each condition, rabbits were exposed at a multislice image acquisition (for a thickness of 3 cm, from the middle to the caudal chest) was obtained. For each condition Xenon wash-in images were acquired to measure regional lung ventilation.

<u>*Radiation microtomography (SR μCT) setting*</u>

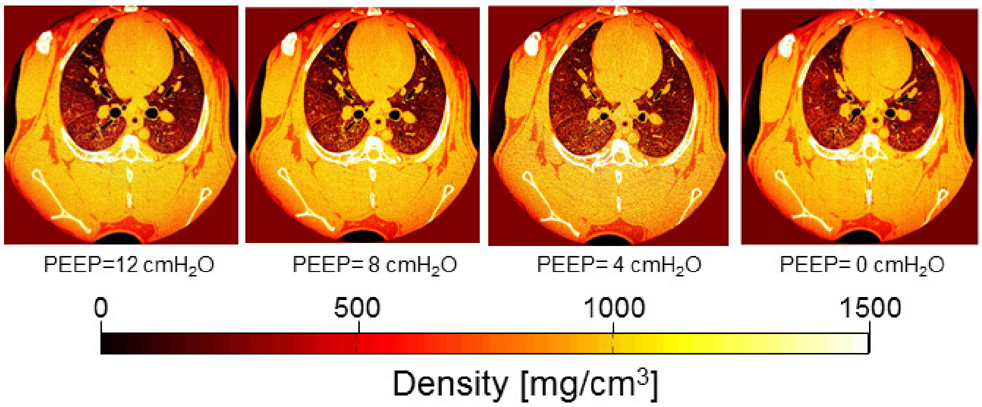
In this phase the Fast Readout Low Noise detector with a spatial resolution of 46.6 microns was used. Because the readout of the FReLoN detector can have motion artifacts in alive animals, generating blurred images, it was necessary to avoid chest wall motion and vascular pulsatility. For this purpose, we moved to a *post-mortem* experiment; we lowered the body temperature putting a cold gel pad around the abdomen in order to delay *rigor mortis*. The computer-controlled system synchronized imaging with the different phases of mechanical ventilation, to reduce motion artifacts. The animals underwent to different PEEP levels: 12, 8, 4, 0 cmH_2O.

In our preliminary data analysis, we generated high-resolution maps (with a pixel size of 47 microns) of tissue density distribution using scripts for the Image Processing Toolbox for MatLab R2008a (MatLab, The MathWorks, Natick, MA).

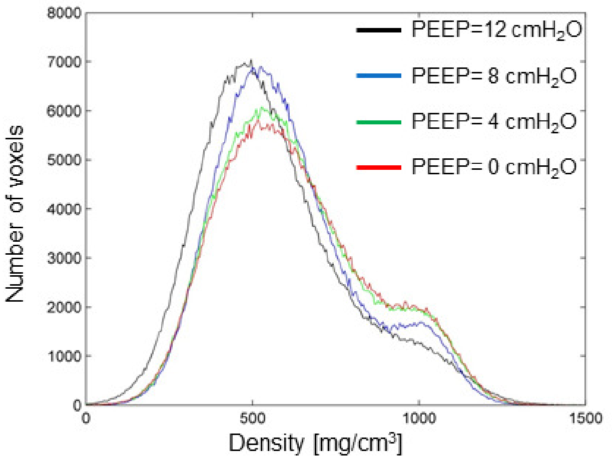
By this method we obtained the voxel densities and their distribution within the lung parenchima. During the image-processing, the lung parenchyma of the CT slices was manually outlined. The mean density of the lung was assessed and compared between the different ventilator settings. (see attached figures)

The experiments were successful and proved the applicability of high-resolution SRCT to imaging of lung parenchyma. Work is still in progress to extract quantitative parameters of respiratory mechanics: they will allow to better understand the onset of airway closure phenomena and intrinsic heterogeneity of parenchyma, even in healthy lungs, when subjected to invasive mechanical ventilation. The data will be fully analyzed and published later

Rabbit #8



Distribution of density at the four levels of PEEP



The figure above depicts the density map of a representative rabbit at the four studied PEEP levels. Note that at low level of PEEP, lungs tend to increase water content.

The figure aside shows the distribution of densities inside the lung of the same representative rabbit. Observe the shifting towards higher values of the peak of density when PEEP is lowered.