

# EARLY EMPHYSEMA DETECTION IN A LARGE SERIE OF HISTOLOGICAL IMAGES

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## INTRODUCTION

The mean linear intercept (Lm) [1] is a commonly used measure to quantify lung emphysema. Although Lm provides a global estimate of airspace enlargement, is unclear whether it is sensitive enough to detect low to mild forms of the disease. Parameswaran et al. in [2] presented three alternative measures (D0, D1, D2), which take into account both the distribution of airspace diameters and its higher statistical moments. To compute all these metrics with reproducibility, no human error and at reasonable speed, we have implemented a fully automatic, parallel software toolset. Further, we have used this toolset to evaluate how these measurements can separate control from emphysema groups (especially at early stages) on a large study of elastase induced emphysema mouse model.

## METHODS

*Animal and sample preparation:* 60 mice were used, equally distributed into control (C) and treated individuals (E). Treated mice were intratracheally instilled with elastase, and control animals with a saline solution. Five animals of each group were sacrificed at hours 1, 6, 12, 24, and days 7 and 17 after treatment. Lungs were excised and thin (4 micron) sections from all lung lobules were fixed and stained with Hematoxylin and Eosin. Full views of all (1500+) sections were acquired as image mosaics at 10x using an automated Axioplan 2ie Zeiss microscope.

*Image analysis:* First, we segmented all alveolar structures using thresholding. The threshold was chosen as the first null of the histogram derivative. Vessels and bronchioles were removed using mathematical morphology and the Lm, D0, D1 and D2 measurements computed. The code was written as to exploit parallelism and the processing was spread on 6 cores.

## RESULTS AND CONCLUSIONS

Figure 1, (left) shows that Lm detects the progression of emphysema. However, on Figure 1 (right), we see that it fails to separate the C from E populations at 6 hours after treatment, while D2 succeeds. We conclude that, while all four measurements were able to detect severe cases of emphysema, D2 was the most sensitive measure of all, being able to clearly detect the disease at early stages.

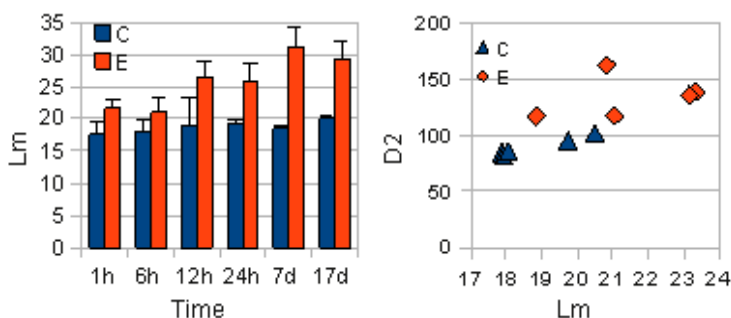


Figure 1. (Left) Emphysema progression given by the Lm measure. (Right) D2 versus Lm on the C and E mice sacrificed 6 hours after treatment.

## REFERENCES

[1] M. Dunnill, "Quantitative methods in the study of pulmonary pathology," *Thorax* 17: 320–328, 1962.

[2] H. Parameswaran, A. Majumdar, I. Satoru, A. M. Alencar, B. Suki, "Quantitative characterization of airspace enlargement in emphysema," *J. App. Phys.*, 100, 186-193, 2006.