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Mini Review

# Structured Light Plethysmography: A Futuristic, Non-Contact Method for Assessing Chest and Lung Function

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## Abstract

Structured Light Plethysmography (SLP) is an innovative, non-invasive imaging modality that captures dynamic thoracoabdominal movements during respiration using projected light patterns and stereo imaging. Initially developed as a tool to evaluate pulmonary mechanics without physical contact or radiation exposure, SLP is gaining attention in both clinical and research domains. This review outlines current and emerging applications of SLP in respiratory medicine, surgery, and paediatrics, and explores its future potential as an adjunct or alternative to traditional pulmonary function tests and imaging modalities.

**Keywords:** Structured Light Plethysmography (SLP); Lung Disease

## Introduction

Accurate assessment of respiratory mechanics is crucial for diagnosing and managing thoracic disorders. Traditional tools such as spirometry, body plethysmography, and radiographic imaging provide valuable structural and functional data but are limited by invasiveness, radiation exposure, and poor regional specificity [1]. Structured Light Plethysmography (SLP) offers a unique solution—capturing real-time, regional chest wall movement through a contactless, radiation-free method. This review summarises the clinical utility of SLP and its growing role in thoracic diagnostics and monitoring. (The Thora-3Di® system, developed by PneumaCare®, utilizes the PneumaView® software for data capture and PneumaView 3D® for data review and analysis.)

## Principles of structured light plethysmography

SLP employs a grid of light projected onto the patient's thoracoabdominal surface, which is captured by dual cameras. As the patient breathes, the deformation of the grid pattern is analysed to quantify regional and global chest wall motion [2]. The data are processed to yield metrics such as tidal displacement, respiratory rate, regional contribution to breathing, and symmetry indices [3] (figures 1-2).

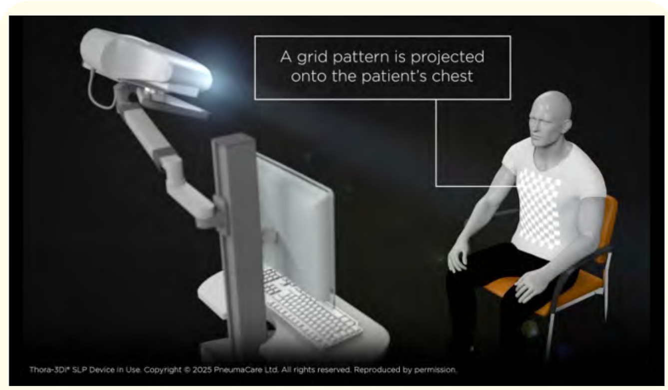


**Figure 1**

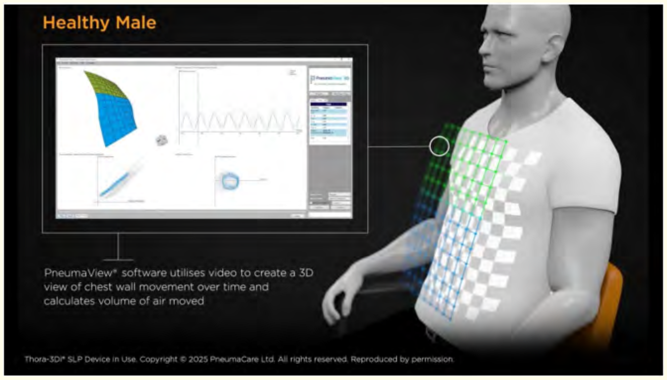


**Figure 2**

## Clinical applications of SLP (figure 3)

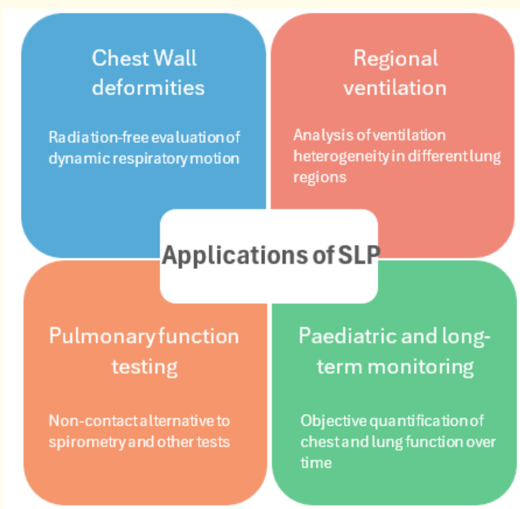


**Figure 3:** Clinical applications of SLP.

## Evaluation of chest wall deformities

SLP has been explored as a tool for functional assessment in patients with pectus excavatum and pectus carinatum. It can quantify anterior chest wall depression, asymmetry, and postoperative improvement, complementing structural imaging and aiding in surgical decision-making [4].

## Pulmonary function assessment

In patients with chronic respiratory diseases such as asthma, COPD, and interstitial lung disease, SLP has been shown to correlate well with spirometric indices [5]. It is particularly beneficial in children or patients unable to perform forced respiratory manoeuvres [1]. Figure 4 illustrates a representative flow-volume curve derived from SLP data, highlighting the inspiratory loop and the IL50 parameter, which correlates with forced expiratory volume in one second (FEV1) and can aid in functional assessment of airflow limitation.

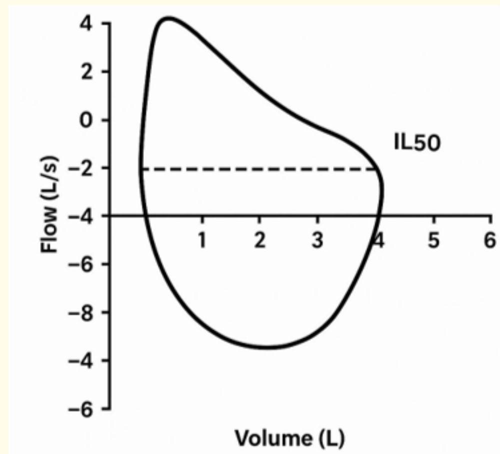


**Figure 4:** SLP – IL50 and flow-volume curve.

## Paediatric applications

SLP is ideally suited for paediatric use due to its non-contact, radiation-free nature. It enables frequent assessments of respiratory mechanics in children with neuromuscular disorders, congenital anomalies, or undergoing thoracic surgery [1].

## Postoperative and rehabilitation monitoring

SLP provides a real-time, dynamic view of respiratory mechanics, making it useful for monitoring post-thoracic surgery patients or those undergoing pulmonary rehabilitation. It can detect asymmetry, restricted regional movement, or compensatory breathing patterns [4].

## Infection control and remote monitoring

During the COVID-19 pandemic, the utility of SLP as a non-contact method was highlighted. It holds promise for telemedicine applications, especially for home-based monitoring of respiratory patients [6].

## Research and technological advancements

Emerging studies are integrating SLP with artificial intelligence to enable automated analysis, anomaly detection, and personalised risk profiling [5]. Integration with 3D printing and AR/VR platforms is also under exploration for surgical simulation and education.

## Limitations and challenges

Current limitations include limited ability to assess posterior or lateral thoracic wall movements and dependence on consistent patient positioning. Further validation in diverse populations and standardisation of protocols are needed to enhance clinical adoption [3,5].

## Future directions

SLP is poised to become a routine component of respiratory assessment. Future research should focus on:

- Multicenter validation studies
- Integration with other diagnostic modalities
- Development of paediatric and disease-specific normative data
- Wearable or portable SLP systems for remote use

## Conclusion

Structured Light Plethysmography is a futuristic, non-contact tool that provides detailed, dynamic insights into chest and lung function. Its unique combination of safety, convenience, and functional output positions it as a valuable adjunct to conventional respiratory diagnostics, particularly in paediatrics, thoracic surgery, and chronic lung disease management.

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