

# METHODS TO ACCURATELY MEASURE DIASTOLIC FUNCTION FROM ECHOCARDIOGRAM

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## Technology Description

Researchers in Prof. Sandor Kovacs' laboratory developed a patented, non-invasive, load-independent method to measure the intrinsic diastolic performance of the heart. This load-independent index of filling (LIIF) can be incorporated into the software of echocardiogram machines for objective analysis and streamlined physician workflow to diagnose heart conditions and monitor therapy or disease progression.

Diastolic function (DF) is influenced by both intrinsic factors (e.g., muscle contractility and stiffness) and extrinsic factors (e.g., load that varies with body position, blood pressure and volume). To accurately measure DF, these factors need to be uncoupled. LIIF offers a reliable, validated ultrasound analysis tool to isolate the intrinsic function based on physics and physiology. LIIF is based on a validated kinematic model and adapted for simple implementation through mathematical analysis of geometric features of routine velocity waves on an echocardiogram (e.g., height, width, slope). LIIF provides a numerical value for dimensionless dynamic diastolic efficiency that varies objectively depending on the level of DF.

## Stage of Research

The inventors derived the load-independent index of filling (LIIF) and validated it experimentally by analyzing E-waves while load was varied using a tilt table to reposition patients. The validation studies compared LIIF in patients with diastolic dysfunction to normal controls.

## Applications

- **Echocardiography software** – clinical tool could be incorporated into the software of echocardiography machines to analyze diastolic function for diagnosis and assessment of therapy or disease progression

## Key Advantages

- **Accurate, objective, direct measure:**
  - analyzes intrinsic heart function, independent of load (e.g., blood pressure, volume, patient position)
  - derived directly from geometric features of the waveform (height, width, slope)
- **Non-invasive** – ultrasound-based diagnostic procedure allows cardiologists to frequently and sequentially assess left ventricle function

## Publications

- Bhagavan, D., Padovano, W. M., & Kovacs, S. J. (2020). [ALTERNATIVE DIASTOLIC FUNCTION MODELS OF VENTRICULAR LONGITUDINAL FILLING VELOCITY ARE MATHEMATICALLY IDENTICAL.](#) *American Journal of Physiology-Heart and Circulatory Physiology*.
- Shmuylovich, L., & Kovács, S. J. (2006). [Load-independent index of diastolic filling: model-based derivation with in vivo validation in control and diastolic dysfunction subjects.](#) *Journal of applied physiology*, 101(1), 92-101.
- [How do you measure a broken heart? Researchers find long-sought answer](#), theSource, Sept. 14, 2006

## Patents

- [Load independent index of diastolic function](#) (U.S. Patent No. 8,355,548)

## Related Web Links

- Kovacs [Profile](#), [Wikipedia](#)