A method of computing strains from full-field data

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PROBLEM STATEMENT

- Generally, the primary output from several full field deformation measurement techniques is digital image. Further correlation is the displacement vector at a dense grid of points covering the area of interest, wherein one is interested in strains which is computed from spatial derivatives of displacement.
- However, computed displacement data inherently **contain noise** & difficult to obtain strains.
- Hence, there is a need to address the issues.

INTELLECTUAL PROPERTY

IITM IDF Ref. 884; IN Patent No: 516322

TECHNOLOGY CATEGORY/ MARKET

Technology: Computing strains from full-field data;
Industry & Application: LCD/ LED Screen;
Market: The global LED display market is projected to grow at a **CAGR** of **7.3%** during **2024-2032.**

TRL (TECHNOLOGY READINESS LEVEL)

TRL-3/4, Proof of Concept ready, tested in lab.

TECHNOLOGY

- Present invention describes a **method** to **compute strains** from **full-field data** using **Principal Component Analysis** (PCA) of displacement field by choosing only the dominant singular values & their corresponding eigenvectors. (Refer Figures)
- The **PCA** is performed by one of two equivalent methods.
- **Demonstrates** the **accuracy** of the present method by applying it to two cases each of **homogeneous & inhomogeneous strain fields** & show that in all cases.
- The method comprises a few steps illustrates in the smart chart herein.

1. Singular Value Decomposition of the displacement data

2. Identification of Dominant Singular values

3. Reconstruction of displacement data in left and right eigenvector bases, and

4. Calculation of displacement gradient and strain using dominant eigenvectors

KEY FEATURES / VALUE PROPOSITION

❖ *Technical Perspective:*

- The claimed method **reduces** the **dimensionality of the displacement data** drastically & **eliminates** a **significant portion of the noise**.
- Further, the shapes of the dominant eigenvectors offer physical insight into dominant deformation patterns.
- The present method **yields excellent results** even when applying it to two cases each of homogeneous & inhomogeneous strain fields.
- Facilitates the **strain computation more accurate, faster & less memory-intensive.**

❖ *Industry Perspective:*

- Applicable in the **full-field displacement data** & facilitates important commercial implications.

RESEARCH LAB

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Images

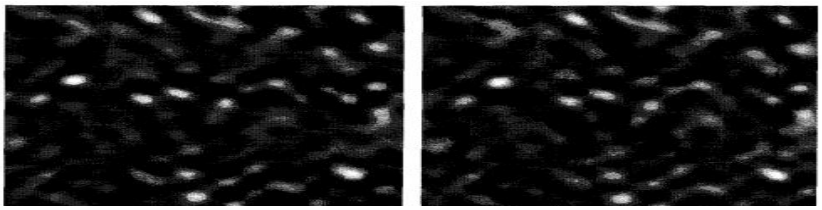

Fig. 1 (Left): Illustrates a 1024X1024 8bit image generated using 10 sinusoids prior to translation (left) & after translation (right).

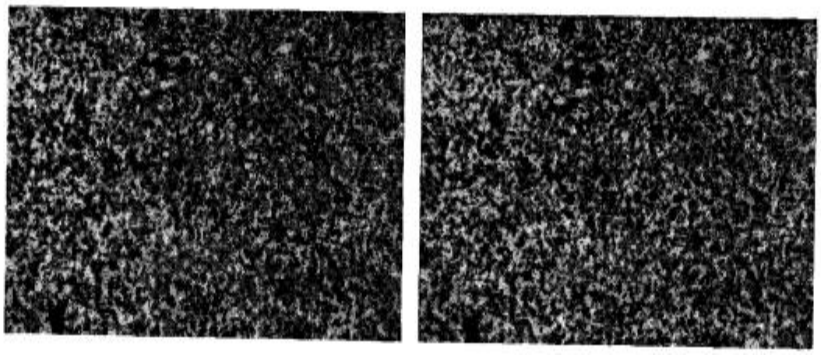

Fig. 2 (Left): Illustrates the speckle-pattern image prior to (left) & after stretching (right) using bi-quintic B-Spline function for interpolation

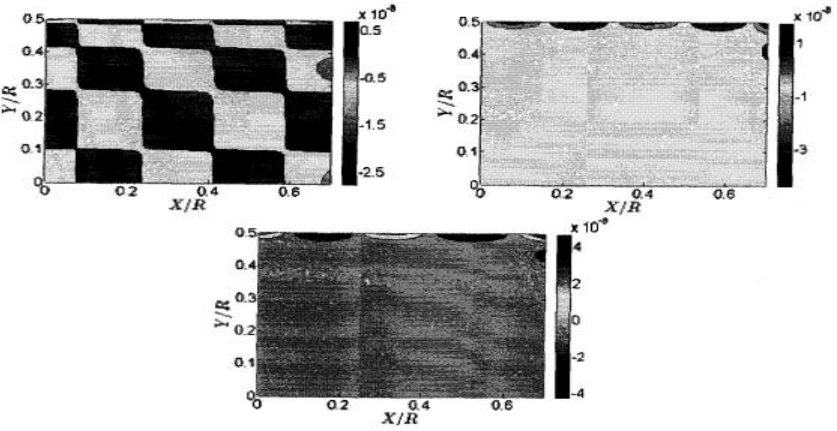

Fig. 3 (Left): Illustrates the error in the three strain components Σ_{XX} (top-left), Σ_{XY} (top-right), Σ_{YY} (bottom).

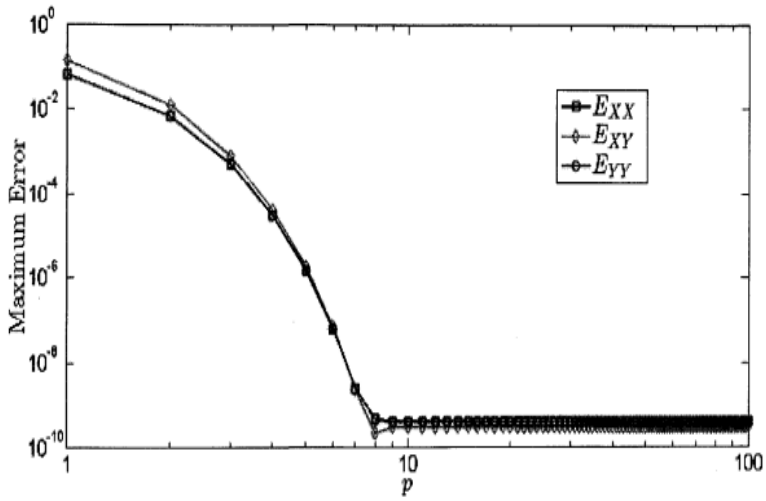

Fig. 4 (Left): Illustrates the variation of maximum strain error with the number of retained principal components.

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