亮点报道：微纳结构显神威——超构透镜解锁数字图像相关技术新维度

DOI: 10.12086/oee.2026.261004.h01

材料与物体表面的变形现象无处不在，并在不同的空间与时间尺度上呈现出差异。数字图像相关技术 (DIC) 作为实验固体力学领域的经典光学诊断手段，已在生物医学、建筑工程、航空航天等众多科学研究与工程应用中得到广泛采用。

香港城市大学陈沐谷助理教授与上海交通大学施圣贤教授、齐飞教授联合提出一种基于超构透镜的数字图像相关技术 (Meta-lens DIC)，该研究尝试将先进光学超材料与传统 DIC 技术融合，使用集成有一片超薄且超轻的双目超构透镜的单个相机拍摄高质量的散斑图像，获取待测表面的三维位移和应变场，探索验证 Meta-lens DIC 技术。作为一种新型光学超材料，超构透镜可以精准操控光的波前，具备超薄、紧凑和无球差的特点，非常适合在有限空间内使用，有望替代传统的光学成像系统。

这项研究将先进微纳光学技术与传统表面应变测量技术相结合，使传统的固体力学测试工具焕发新的活力，并针对便携易用、受限空间等测量场景，拓展了 DIC 技术和光学超材料技术的应用潜力，为 DIC 技术的小型化等方面的应用研究提供了新思路。

Highlights: Revolutionizing digital imaging correlation: meta-lens open new horizons

DOI: 10.12086/oee.2026.261004.h01

Digital Image Correlation (DIC) is an optical technique . It uses a speckle pattern or natural texture, tracking surface changes under load via image analysis. This technique faces challenges in calibration, synchronization, portability, and precision driving the need for innovative, compact optical solutions suitable for non-laboratory environments.

To address the challenges of traditional DIC systems, Prof. Mu Ku Chen from the City University of Hong Kong, along with Prof. Shengxian Shi and Prof. Fei Qi from Shanghai Jiao Tong University, proposed a novel Meta-lens DIC technology. This research integrates advanced optical meta-lenses with traditional DIC techniques. The research team implemented a pair of meta-lenses and integrated them into a CMOS sensor, creating a compact binocular meta-lens camera. This camera is significantly smaller than those equipped with a single commercial lens, and the binocular meta-lens itself weighs only 116 mg, much lighter than commercial lenses.

This study combines advanced micro-nano optical technology with traditional surface strain measurement techniques, breathing new life into classical solid mechanics testing tools. It expands the potential applications of DIC and optical metamaterial technologies for compact, portable, and space-constrained measurement scenarios, providing new insights for the miniaturization of DIC systems.

Opto-Electronic Advances, 2025, **8**(9): 250014.
https://www.oejournal.org/article/doi/10.29026/oea.2025.250014
英文报道摘自 https://www.eurekalert.org/news-releases/1101271