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## **Label-Free Histology through Microstructured Optical Windows**

*University of Milano-Bicocca, Milano, Italy*

**Giuseppe Chirico**  
**Email: [Giuseppe.chirico@unimib.it](mailto:Giuseppe.chirico@unimib.it)**

The diagnosis of many pathologies is traditionally based on ex-vivo histological tissue sections. This process is time-consuming, subjective, and invasive. Transitioning to in-vivo label-free microscopy presents significant advantages. With this aim, we developed and tested high numerical aperture microlens optics in a laboratory setting, enhancing the feasibility of implementing non-linear microscopy in vivo. We explore how implantable micro-optics, when combined with higher-order non-linear excitation microscopy, improve light penetration, facilitate label-free tissue analysis, and mitigate tissue damage. Additionally, we assess the thermal load induced by the high laser intensities required for advanced non-linear imaging. Various microlens designs have been laser-fabricated, replicated via nano-imprinting lithography, and implanted in chicken embryos. Through Machine learning methods, we achieve a good segmentation and identification of immune cells, vessels, and collagen. Promising results suggest that similar analyses can be performed at depths of several hundred microns in mice.

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### **Short Bio:**



Giuseppe Chirico received his PhD in biophysics in 1990 from the University of Milano (I). He is professor of Applied Physics at the University of Milano-Bicocca (I). His activity covers biophysics, non-linear excitation microscopy and microfabrication and nanotechnology.