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Adaptive wave-front correction for multi-photon microscopy using coherence-gated wave-front sensing MARKUS RUECKEL, WINFRIED DENK, Max-Planck Institute for Medical Research, Germany — The contrast and the resolution of a multi-photon microscope highly depend on the shape of the focus which can be distorted by refractive index inhomogeneities within the specimen. Coherence-gated wave-front sensing (CGWS) allows reliable adaptive wave-front correction of these distortions (M. Feierabend, M. Ruckel, and W. Denk, Optics Letters, 2004, 29(19)). We developed a model for CGWS for which we evaluated in detail, using Monte-Carlo simulations, how the measured wave-fronts depend on the density of scatterers, the position and length of the coherence gate, and on the polarization of the light used. Predictions from this model were confirmed experimentally. Further we report on early results from an exploration of how much the two-photon excitation efficiency improves when applying corrections as predicted by CGWS. Experiments and numerical simulations show for a wave-front with a RMS distortion of $\lambda/5$ that the excitation efficiency was about 60% of that for a diffraction-limited focus. This was done for both astigmatism and coma.

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