Static thermo-optic instability in double-pass fiber amplifiers

A coupled-mode formalism, earlier used to describe transverse mode instabilities in single-pass optical fiber amplifiers, is extended to the case of double-pass amplifiers. Contrary to the single-pass case, it is shown that the thermo-optic nonlinearity can couple light at the same frequency between the LP01 and LP11 modes, leading to a static deformation of the output beam profile. This novel phenomenon is caused by the interaction of light propagating in either direction with thermo-optic index perturbations caused by light propagating in the opposite direction. The threshold power for the static deformation is found to be several times lower than what is typically found for the dynamic modal instabilities observed in single-pass amplifiers. (C) 2016 Optical Society of America