The occupation of $d$-orbitals has a key influence on the physical properties of transition-metal (TM) oxides.\textsuperscript{1} Due to the strong hybridization with neighboring oxygen ions, the electronic structure is very sensitive to changes in the TM-oxygen bond distances induced by strain and/or by the chemical bonding to other ions with different electronic configuration. Both effects might be important in oxide heterostructures,\textsuperscript{2} but thus far it has been difficult to probe atomic-scale modulations of the orbital occupation in a quantitative manner.\textsuperscript{3} We present results from polarized soft x-ray resonant reflectivity, which demonstrate that it is possible to derive quantitative, spatially resolved orbital polarization profiles. We show that this method is sensitive enough to resolve differences of $\sim 3\%$ in the occupation of Ni $e_g$ orbitals in adjacent atomic layers of a LaNiO$_3$-LaAlO$_3$ superlattice, and the experimental findings are in good agreement with electronic-structure calculations. The possibility to quantitatively correlate theory and experiment on the atomic scale opens up new perspectives for orbital physics in oxide heterostructures.

\textsuperscript{1}Tokura, Y. \& Nagaosa, N. Science \textbf{288}, 462-468 (2000).