High-order numerical simulations of the flow around wings at moderately high Reynolds number[1] RICARDO VINUESA, PRABAL NEGI, SEYED M. HOSSEINI, ARDESHIR HANIFI, DAN S. HENNINGSON, PHILIPP SCHLATTER, Royal Institute of Technology (KTH) — The results of a DNS of the flow around a wing section represented by a NACA4412 profile, with $Re_c = 400,000$ and 5° angle of attack, are presented in this study. The high-order spectral-element code Nek5000 was used for the computations. The Clauser pressure-gradient parameter β ranges from $\simeq 0$ to 85 on the suction side, and the maximum Re_θ and Re_τ values are around $2,800$ and 373, respectively. The adversre pressure gradient (APG) on the suction side of the wing leads to a progressively increasing value of the inner peak in the tangential velocity fluctuations, as well as the development of an outer peak, which is also observed in the other components of the Reynolds-stress tensor. Close to the trailing edge, i.e., at $x/c \simeq 0.9$, the outer peak in the inner-scaled tangential velocity profile is larger than the inner peak. These effects are connected to the fact that the large-scale motions of the flow become energized due to the APG, as apparent from spanwise-premultiplied power spectral density plots. Preliminary comparisons between DNS and well-resolved LES data, based on a relaxation-term filtering approach, are also presented with the aim of further extending the Reynolds number to $Re_c \simeq 1,000,000$.

Ricardo Vinuesa
Royal Institute of Technology (KTH)