On the optimization of a wind tunnel by CFD

S. Neves[1], J.B.L.M. Campos[1,2], T. Sotto Mayor[3]

[1] Dep. de Engenharia Química, Faculdade de Engenharia, Universidade do Porto (FEUP), Portugal.
[2] Centro de Estudos de Fenómenos de Transporte (CEFT), Portugal.
[3] Centro de Nanotecnologia e Materiais Técnicos, Funcionais e Inteligentes (CeNTI), Portugal.

Clothing consumers are becoming more demanding about products quality and associated comfort. In order to meet this demand it is important to improve techniques and methods to evaluate the performance of products in representative conditions.

The clothing thermal performance can be evaluated using thermal manikins and climate chambers (Fig. 1). The former allows the monitoring of heat losses across the garments whereas the latter allows the precise control of the test conditions (temperature, humidity and air speed).

The purpose of this project is to adapt the geometry of an existing climatic chamber to allow the imposition of wide range of air speeds [1-2]. Therefore, a computational tool (COMSOL Multiphysics 3.5) was used to simulate numerically the fluid flow inside the chamber, in order to identify ways to homogenise the velocity profile inside a "wind tunnel" to be placed in the chamber interior.

Several parameters were studied, namely the test zone position, the shape of the climate chamber corners and the wind tunnel geometry. The wind tunnel was found to assure more symmetrical velocity profiles when placed at the chamber centre, whereas the chamber corners were found to have negligible influence on the velocity profiles at the test zone and. The shape of the wind tunnel contraction was optimized (Fig. 2).

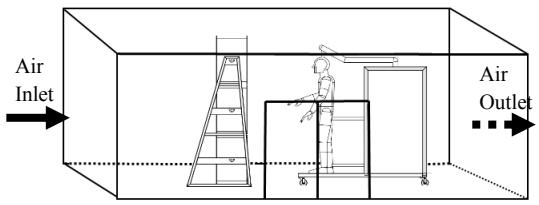

Figure 1 - Climatic chamber, dummy and fans

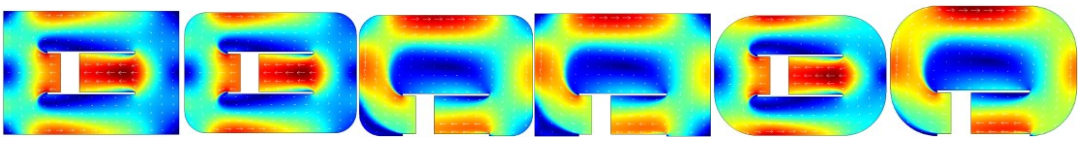

Figure 2 – Influence of the climatic chamber's geometry and wind tunnel position on the flow characteristics (velocity distribution on the climatic chamber - transversal cut)

References:

[1] Lindgren, B. and Johansson, A. V., *Design and Evaluation of a Low-Speed Wind-Tunnel with Expandig Corners*, Royal Institute of Technology: Stockholm (2002)

[2]Moonen, P., Blocken, B., et al, *Numerical modelling of the flow conditions in a closed-circuit low-speed wind tunnel*. International Journal of Wind Engineering and Industrial Aerodynamics, 94: p. 699-723 (2006)