RADIATIVE TRANSFER IN A SEMI-TRANSPARENT CAVITY WITH REFLECTING SURFACES AND A CENTRED OBSTACLE

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An exact semi-analytical determination of the incident radiation and radiative flux inside a non-isothermal grey absorbing-emitting semi-transparent medium enclosed in a square cavity with reflecting surfaces, which contains a centered square opaque and reflecting obstacle is proposed.

Due to the reflection at all the surfaces, the radiosity technique is used to determine the radiosity temperatures on the surfaces, taking into account the non-isothermal medium, before including them in the calculation of the incident radiation. The surfaces integrals are fully developed by using the Altaç angular integrated Bickley-Naylor functions of order 2, while the double angular and space integrals are partially discretized with the help of a Gauss quadrature on an adequate meshing grid, following an iterative scheme to calculate the temperature field at radiative equilibrium. Once the temperature distribution is obtained (Figure 1a), the radiative flux vector inside the participating medium is calculated by using the Altaç functions of order 3 associated to the surfaces integrals and ultimately the radiative flux intensity (Figure 1b).

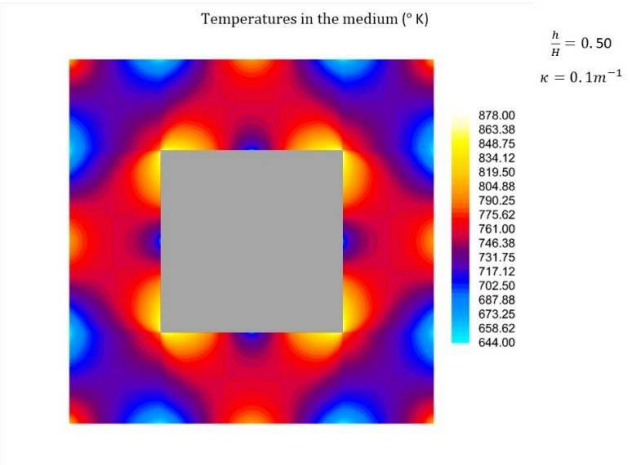

Figure 1a) Temperature in the medium

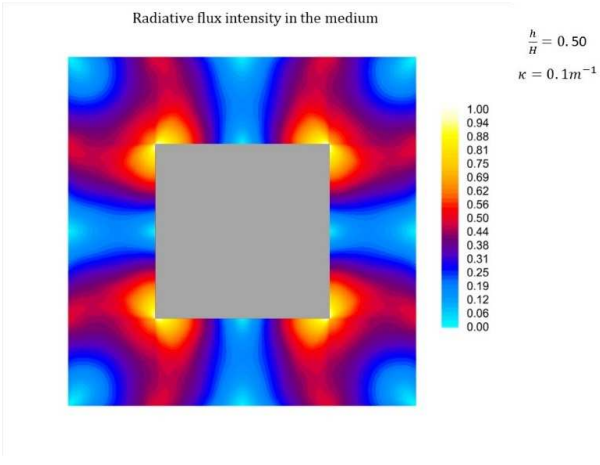

Figure 1b) Radiative flux intensity

An accuracy criterion based on the surface radiative normal flux integrated on internal centred virtual squares is proposed, and the effects of different parameters such as the size of the square inner obstacle, the surface emissivities and the medium's absorption coefficient, on the cavity's temperature field and the radiative flux field behavior at radiative equilibrium is investigated.

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