

VON KARMAN INSTITUTE FOR FLUID DYNAMICS  
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UNIVERSITAT POLITÈCNICA DE CATALUNYA  
ESCOLA SUPERIOR D'ENGINYERIES INDUSTRIAL, AERONÀUTICA I AUDIOVISUAL DE TERRASSA

# **Assessment of Gas-Surface Interaction Modelling for Lifting Body Re-Entry Flight Design**

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Thesis presented by Dipl.-Ing. Alan Viladegut Farran in order to obtain the degree of *Doctor en Mecànica, Fluids i Aeronàutica*, Universitat Politècnica de Catalunya, Barcelona, 26 September 2017.

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# Errata

for thesis with title:

## Assessment of Gas-Surface Interaction Modelling for Lifting Body Re-Entry Flight Design

presented on December 1, 2017

Alan Viladegut Farran

- P. 30: The Stefan-Maxwell equations (Eq. 3.18-3.19) should include the mass conservation constraint  $\sum_{i=1}^{N_s} \vec{J}_i = 0$
- P. 119: The thickness of the C/SiC panel is changed to 2 mm, and values for  $\lambda_{C/SiC}$  and  $Bi$  are updated to  $\lambda_{C/SiC} = 8 \text{ W/mK}$  and  $Bi = 1.13 \times 10^{-2}$ , respectively.
- P. 120, line 3: lines reading:

*“In CATE, thermocouple measurements are taken at 1 Hz, therefore  $\Delta t = 1 \text{ s}$  is taken as reference. Then,  $\rho = 205 \text{ kg/m}^3$  and  $c_p = 750 \text{ J/kgK}$  for C/SiC, leading to  $Fo = 90.33$ ”*

are replaced by:

*“In CATE, thermocouple measurements are taken at 1 Hz, and one could be prone to take  $\Delta t = 1 \text{ s}$  as reference. However, such  $\Delta t$  might not represent properly the surface temperature variation throughout the trajectory, and another criteria more focused on the flight physics should be used. For instance, considering the flight condition at  $t = 4521 \text{ s}$  from lift-off, where the maximum temperature jump due to the catalytic transition is observed on shingle 3 (see Table 6.6), data provided by thermocouple WT23 show that it takes 60 s to reach a variation of 1% in the surface temperature measurement. Then, if  $\rho = 2050 \text{ kg/m}^3$  and  $c_p = 1600 \text{ J/kgK}$  for C/SiC at  $T_w > 1200 \text{ K}$ , one obtains  $Fo = 36.59$  for that specific flight condition”.*