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Reply

Reply to Comment on 'A new method to measure electron density and effective atomic number using dual-energy CT images'

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Abstract

In this note, we would like to respond to the comments made by Professor Bouchard on our recent published work and clarify some aspects of it.

Keywords: tissue characterization, dual-energy CT, electron density, effective atomic number

(Some figures may appear in colour only in the online journal)

First of all, it is worth mentioning that the method proposed by Bourque *et al* (2014) and our method are non-parametrical in the sense that both do not assume any predefined functional form of the attenuation coefficients. Bourque's method uses a polynomial expansion which it was originally proposed by Midgley (2004) as they expose in the last paragraph of page 2061 of their paper.

Although the definition of dual energy ratio in equation (24) of our paper is slightly different from the Bourque's definition; we have to note that we use Bourque's definition (i.e. $C_0^L = C_0^H = -1000$) for estimate the calibration curve $Z_{\text{eff}}(\Gamma)$ in our implementation of Bourque's method.

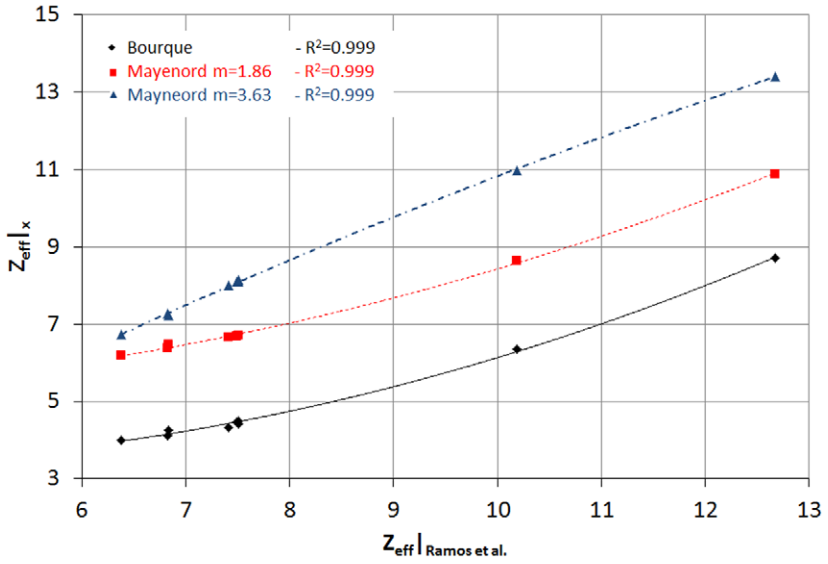

Figure 1. Z_{eff} calculated using different definitions versus the Z_{eff} calculated using equation (23) of our paper.

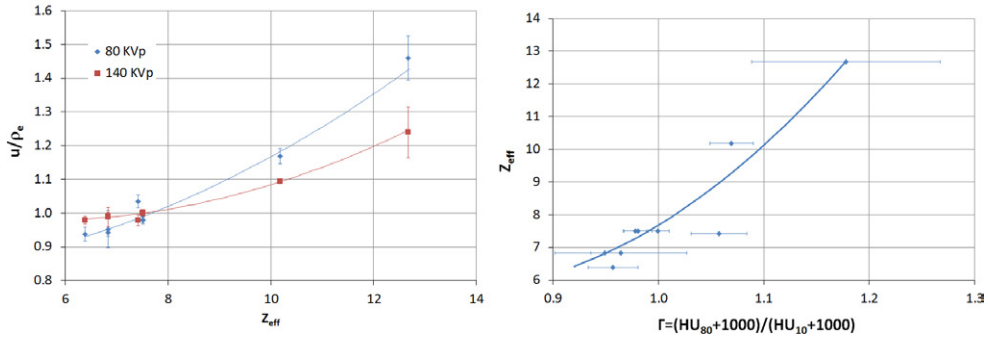

Figure 2. Calibration curves used for the implementation of the Bourque's method. The uncertainties were used in the fitting processes. The uncertainties of Γ were calculated using the standard formula for the propagation of the imprecision and were taken into account using the effective variance method (Orear 1982).

It is true that in our work, the quotient of the reduced Hounsfield units and the electron density was fitted as a function of Z_{eff}, but this should be equivalent to the $\mathrm{HU}(\rho_e^{e,\,\mathrm{tissue}} Z_{\mathrm{eff}})$ fit if the uncertainties are properly taken into account in the process (Bevington and Robinson 1969).

As professor Bourque kindly exposes, our definition of Z_{eff} is different to the definition proposed in the Bourque's paper. Our definition of Z_{eff} is explicitly stated in equation (23) of our paper and, although different, is very closely related to the definition used by Bourque *et al*. In figure 1, we show the relationship between our Z_{eff}, the Z_{eff} proposed by Bourque *et al* and the Z_{eff} calculated using the Mayenor definition.

Finally, polynomials of degree 2 are used for the calibration curves of $\frac{u}{\rho_e^{w,\,\mathrm{tissue}}}(Z_{\mathrm{eff}})$ and $Z_{\mathrm{eff}}(\Gamma)$. Figure 2 shows the calibration curves.

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