# Cramér-Rao bounds and condition number in SPECT: Comparison between conventional thin holes collimator and emission tomography project with large and long holes collimators



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| Résumé en anglais | **Objectives:**<br>The project of emission tomography with large and long holes collimators (CACAO-TROLL), was proposed some time ago. The use of collimators with larger holes is intended to increase the number of photons detected and therefore the information available to reconstruct the images. This project is however exploratory and most research works in SPECT stick today to the conventional thin hole collimator (CTHC). It may be objected that if the number of photons increases, the information conveyed by each photon is lower. This thought is however inconsistent with our previously published demonstration using information theory. We develop here another approach.<br>**Methods:**<br>We first derived a formula to express the response function of the CACAO-TROLL acquisition, taking a complete account of the depth dependence and the attenuation of the gamma ray in the collimator. The conventional SPECT response function was modelled by using the formula of Youngho Seo (JNM 2005 vol 46 n 5 pp 868) standing for a VPC-45 LEHR collimator. For both projects, various parameters were tested in a 2D reduction of the problem in the transverse plane.<br>**Results:**<br>The results show a slight shift between the behaviour of the condition numbers and the Cramér-Rao bounds. For small image size (less than 30x30) the CACAO-TROLL project exhibits a lower condition number than CTHC, and higher Cramér-Rao bounds. For larger sizes, both factors increase steeply for CTHC. Finally, for a proper choice of the holes geometry, the Cramér-Rao bound is more than an order of magnitude better for the CACAO-TROLL project than for CTHC.<br>**Conclusions:**<br>This calculation confirms, at least in theory, that increasing the number of collected photons and the accuracy of the collimation can lead to better estimates in emission tomography. A good algorithm to fully benefit from this improved acquisition may remain a challenging point. It is to be expected that this calculation may stimulate such research in a near future. |
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