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COMMENT

On an integral with modified Bessel function

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Abstract. The definite integral over $I_0(z)$ evaluated by Bakulev is shown to be a special case of a tabulated integral.

In a recent paper having this title Bakulev [1] went through considerable difficulty to evaluate the integral (slightly rewritten)

$$\int_{0}^{a} I_{0}(\sqrt{a^{2}-x^{2}}) \cosh(Ax) \, \mathrm{d}x = \frac{\sinh(a\sqrt{1+A^{2}})}{\sqrt{1+A^{2}}}.$$
 (1)

The purpose of this comment is to point out that equation (1), its generalization

$$\int_{0}^{a} (a^{2} - x^{2})^{\nu/2} I_{\nu}(\sqrt{a^{2} - x^{2}}) \cosh(Ax) \, \mathrm{d}x = \sqrt{\frac{2a}{\pi}} a^{\nu} \frac{I_{\nu+1/2}(a\sqrt{1 + A^{2}})}{(\sqrt{1 + A^{2}})^{\nu+1/2}} \tag{2}$$

together with a large number of others, which appear to be new, can actually be found in standard tables if one realizes that $\cosh(z)$, $\cos(z)$, $J_{\nu}(z)$ and $I_{\nu}(z)$, etc, are the same functions under the imaginary scale transformation $z \rightarrow iz$. For example,

$$J_{\nu}(iz) = i^{\nu} I_{\nu}(z).$$
 (3)

Thus, (2) is the analytic continuation of equation (1.13) (50) of [2] with $b \rightarrow i$ and $y \rightarrow iA$.

References

[1] Bakulev A P 1991 J. Phys. A: Math. Gen. 24 5747

[2] Erdelyi A et al 1954 Tables of Integral Transforms vol 1 (New York: McGraw Hill)