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On the modification of Euler-Maclaurin summation formula connected with the Chebyshev quadrature formulae

Starting from the Euler-Maclaurin formula for calculating the finite sums $S_n - \frac{1}{h}\int_{x_0}^{x_n} f(x)dx = -\frac{1}{2}(f_n - f_0) + \frac{h}{12}(f_n^{'} - f_0^{'}) - \frac{h^3}{720}(f_n^{'''} - f_0^{'''}) + \ldots$this paper proposes the modification of the summation formula $S_n = \frac{1}{m}\sum_{\nu=0}^{n-1}\sum_{i=1}^{m} f_{a_i+\nu}$ y means of the maximal degree of algebraic accuracy. Using some properties of Bernoulli numbers, it is proved that the values a_i (which are equal to zero in original Euler-Maclaurin formula) can be acquired from the following system of equations: $\sum_{i=1}^{m} a_i^k = \frac{m}{k+1}, \quad k = 1, 2, 3, \ldots, m,$ which is solved. The obtained modified summation formula has some features which lead to the Chebyshev formulae for the numerical integration. Finally, the error term estimation of the obtained summation formula gives: $R \approx h^m \sum_{j=0}^{m} \frac{B_j}{(m+2-j)!j!}\ (f_n^{(m)} - f_0^{(m)})$which is additionally elucidated.

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