4. Digital Filtering Algorithm

The Fast Fourier Transformations (FFT) has better filtering function and fast data processing time, and can be used to filter harmonics [3，4], however it will bring error when the input signal contains decaying DC component. For analyzing FFT algorithm error, it is assumed that the current contains a decaying DC component and no more than the *h-th* harmonics, then the current can be approximated by

$$i(t) = Ae^{-at} + \sum_{i=1}^{h} I_m(i)\sin(i\omega t + \varphi_i) \qquad (14)$$

where Ae^{-at} is the decaying DC component; I_m is the peak component of the *i-th* harmonic current; f_i is the fundamental frequency; φ_i is the phase angle of the *i-th* harmonic component's.

$$I_{\mathrm{Re}}(n) = \frac{2}{T}\int_0^T i(t)\cos n\omega t dt = I_m(n)\sin\varphi_n + \frac{2}{T}\int_0^T Ae^{-at}\cos n\omega t dt \qquad (15)$$

where $I_{\mathrm{Re}}(n)$ and $I_{Im}(n)$ are respectively the real part and the imaginary part of the amplitude value of the *n-th* harmonics component.

5. Calculation Result

In order to validate the method's feasibility, take two groups actual 41kA breaking current for examples to obtain fundamental component. At different breaking time experiment data and pick-up fundamental component are respectively shown as figure in fig.4.

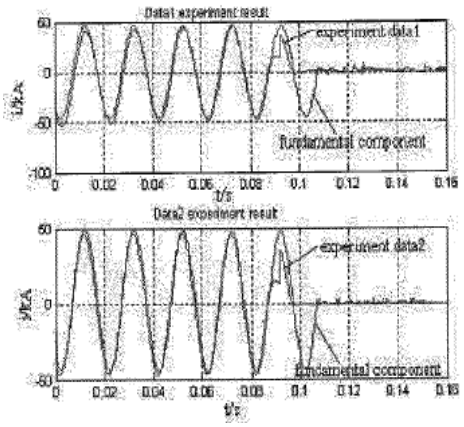

Fig.4. 41kA breaking current different breaking cases

References

[1] Rogowski Coils Application Note, JJ Systems Ltd., Hampshire, England, 2000.

[2] Z. Moravej, D. N. Vishwakarma and S. P. Singh," Digital Filtering Algorithms for the Differential Relaying of Power Transformer: An Overview", Electric Machines and Power Systems, 28, pp.485-500, 2000.

[3] Wei wei，Xu Sheng-hui，Guo Xincao,et al.Design of a New Universal Digital Trigger with CPLD [J].Chinese Journal of Electron Devices, 2008.31(4):1268-1272

[4] L. Han, R. Menzies, J. F. Peters and L. Crowe, " High Voltage Power Fault-Detection and Analysis System: Design and Implementation" , Proceeding of the 1999 IEEE Canadian Conference on Electrical and Computer Engineering Shaw Conference Center, Alberta, Canada, pp.1253-1258, 1999.