In short, I submit that in addition to the motivation in Yau and Tang's paper, ULC devices are fundamental in the development of entirely new digital apparatus with a powerful performance in tasks of pattern recognition, automatic control, and artificial intelligence.

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## Comment on "Negative Radix Conversion"

In the above paper,[1] Zohar discussed negative radix properties, but did not reference most of the earlier pertinent publications [1]–[6].

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[3] Z. Pawlak and A. Wakulicz, "Use of expansions with a negative basis in the arithmometer of a digital computer," *Bull. Acad. Pol. Sci.*, cl. 3, vol. 5, Mar. 1957, pp. 232–236.
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[6] M. P. De Regt, "Negative radix arithmetic," *Computer Design*, vol. 6, May 1967, pp. 52–63. (First of a series of articles.)

Manuscript received March 2, 1970.

## Another Comment on "Negative Radix Conversion"

I have recently read the above paper[1] with interest. The idea of negative radix is not new, and has been dealt with in a series of papers, some of which are noted in the references. We have in Poland over ten computers built on this principle, which have been working for over ten years. This information may be of interest to people working on the subject in the U.S.A.

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Manuscript received May 20, 1970; revised September 10, 1970.
[1] S. Zohar, *IEEE Trans. Computers*, vol. C-19, Mar. 1970, pp. 222–226.

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## Author's Reply[2]

My paper "Negative Radix Conversion," contained the only reference known to me at the time [1].

Let me describe briefly the algorithms considered in this paper. The main feature is an algorithm that converts integers given in base $|q|$ to their representation in base $-|q|$ (and its hardware implementation for $|q|=2$). The conversion uses positive radix arithmetic and will be referred to henceforth as algorithm $P$. For completeness, the much simpler conversion from base $-|q|$ to base $|q|$ (algorithm $T$) was also considered. Comparison of algorithms $P$, $T$ led to an alternate for algorithm $P$. This alternate, referred to henceforth as algorithm $N$, has the disadvantage of requiring negative radix arithmetic.

A review of Wadel's [1]–[6], has shown that algorithms $T$, $N$ had previously been described by M. P. De Regt [6]. Algorithm $P$, however, still appears to be new. Another algorithm requiring negative radix arithmetic has been described by Wadel [2]. His algorithm is restricted to bases $\pm 2$. Its performance is comparable to that of algorithm $N$ but its generalization to bases $\pm|q|$ is inferior to algorithm $N$. An algorithm that converts a number in an unspecified representation to base $-|q|$ is described in [4]. Its performance when applied to conversion from base $|q|$ to base $-|q|$ is rather awkward and slow compared to algorithm $P$.

References [1], [3] are pertinent in a different context. They relate to the credit for the idea of a negative radix. Judging from my [1], I had erroneously ascribed this idea to M. P. De Regt. References [1], [3] seem to indicate that the idea was independently formulated at about the same time by Z. Pawlak and W. Wakulicz [3] in Poland and L. B. Wadel [1] in the U.S.A. Finally, [5] is identical with Pawlak's [2] and is handled below.

A few words regarding Pawlak's comment. His reference [1] is identical with Wadel's [3] already discussed above. His references [2], [3] do not deal with the topic of my paper, namely, conversion.

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REFERENCE

[1] News item in *Electronics*, vol. 40, Dec. 25, 1967, pp. 40–41. The idea of a negative radix is credited here to M. P. De Regt.

[2] Manuscript received May 25, 1970 and August 6, 1970.

## Comment on "An Algorithm for a Fast Hadamard Matrix Transform of Order Twelve"

**Abstract—A recently proposed matrix factorization for a Hadamard matrix of order twelve is shown to be invalid in that the factored matrix is not Hadamard.**

**Index Terms—Hadamard matrix, Hadamard transform, matrix factorization.**

The above-mentioned note[1] by W. K. Pratt reports a matrix factorization for a Hadamard matrix of order twelve. He first presents a construction for a Hadamard matrix of order twelve which is due to Paley[2], and

Manuscript received May 11, 1970.
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