(19) **United States**

(12) **Patent Application Publication** (10) Pub. No.: US 2022/0393703 A1

ZHANG et al. (43) Pub. Date: **Dec. 8, 2022**

(54) **DECODING SYSTEMS AND METHODS FOR LOCAL REINFORCEMENT**

(71) Applicant: **SK hynix Inc.**, Gyeonggi-do (KR)

(72) Inventors: **Fan ZHANG**, Fremont, CA (US); **Seyhan KARAKULAK**, San Jose, CA (US); **Aman BHATIA**, San Jose, CA (US)

(21) Appl. No.: **17/339,285**

(22) Filed: **Jun. 4, 2021**

**Publication Classification**

(51) **Int. Cl.**
| | |
|---|---|
| *H03M 13/37* | (2006.01) |
| *G06F 11/10* | (2006.01) |
| *H03M 13/00* | (2006.01) |

(52) **U.S. Cl.**
CPC ..... *H03M 13/3707* (2013.01); *G06F 11/1076* (2013.01); *H03M 13/616* (2013.01)

(57) **ABSTRACT**

Embodiments of the present disclosure provide a scheme for decoding over a small subgraph which highly likely includes some errors. A controller is configured to: control the first decoder to decode the data, read from the memory device, using a parity check matrix for the error correction code; extract one or more subgraphs from the entire bipartite graph of the parity check matrix, which is defined by a plurality of variable nodes and a plurality of check nodes when a particular condition satisfied; and control the second decoder to decode the decoding result of the first decoder using a submatrix of the parity check matrix corresponding to the extracted subgraphs.

<u>2</u>