

(51) International Patent Classification:
G06N 7/00 (2006.01)(21) International Application Number:
PCT/IB2021/052310(22) International Filing Date:
19 March 2021 (19.03.2021)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
16/842,921 08 April 2020 (08.04.2020) US(71) Applicant: **INTERNATIONAL BUSINESS MACHINES CORPORATION** [US/US]; New Orchard Road, Armonk, New York 10504 (US).(71) Applicants (for MG only): **IBM (CHINA) INVESTMENT COMPANY LTD.** [CN/CN]; 25/F, Pangu Plaza, No. 27, Central North 4th Ring Road, Chaoyang District, Beijing 100101 (CN). **IBM DEUTSCHLAND GMBH** [DE/DE]; IBM-Allee 1, 71139 Ehningen (DE).(72) Inventors: **ASIF, Umar**; c/o IBM IBM Research, 60 City Road, Southbank, Victoria 3006 (AU). **ROY, Subhrajit**; c/o IBM IBM Research, 60 City Road, Southbank, Victoria 3006 (AU). **TANG, Jianbin**; c/o IBM IBM Research,60 City Road, Southbank, Victoria 3006 (AU). **HARRER, Stefan**; c/o IBM IBM Research, 60 City Road, Southbank, Victoria 3006 (AU).(74) Agent: **DOEHLER, Denis**; c/o IBM Deutschland GmbH, Patentwesen und Urheberrecht, IBM-Allee 1, 71139 Ehningen (DE).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, IT, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM,

(54) Title: GENERATING THREE-DIMENSIONAL SPIKES USING LOW-POWER COMPUTING HARDWARE

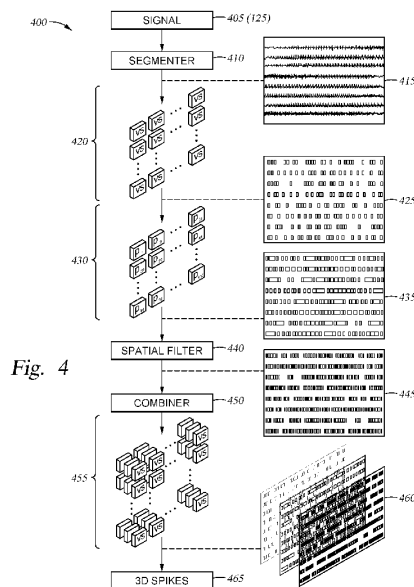


Fig. 4

(57) Abstract: A method of generating three-dimensional (3D) spikes. The method comprising receiving a signal comprising time-series data and generating a first two-dimensional (2D) grid. Generating the first 2D grid comprises mapping segments of the time-series data to respective positions of the first 2D grid, and generating, for each position, a spike train corresponding to the respective mapped segment. The method further comprises generating a second 2D grid including performing, for each position, a mathematical operation on the spike train of the corresponding position of the first 2D grid. The method further comprises generating a third 2D grid including performing spatial filtering on the positions of the second 2D grid. The method further comprises generating a 3D grid based on a combination of the first 2D grid, the second 2D grid, and the third 2D grid. The 3D grid comprises one or more 3D spikes.

TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,
KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*