



(51) International Patent Classification:

A61F 2/60 (2006.01) A61F 2/50 (2006.01)
A61F 2/62 (2006.01)

(21) International Application Number:

PCT/US2013/045356

(22) International Filing Date:

12 June 2013 (12.06.2013)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

61/658,568	12 June 2012 (12.06.2012)	US
61/662,104	20 June 2012 (20.06.2012)	US
61/679,194	3 August 2012 (03.08.2012)	US

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(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, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, 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, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, 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, 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, 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))
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))

[Continued on next page]

(54) Title: PROSTHETIC, ORTHOTIC OR EXOSKELETON DEVICE

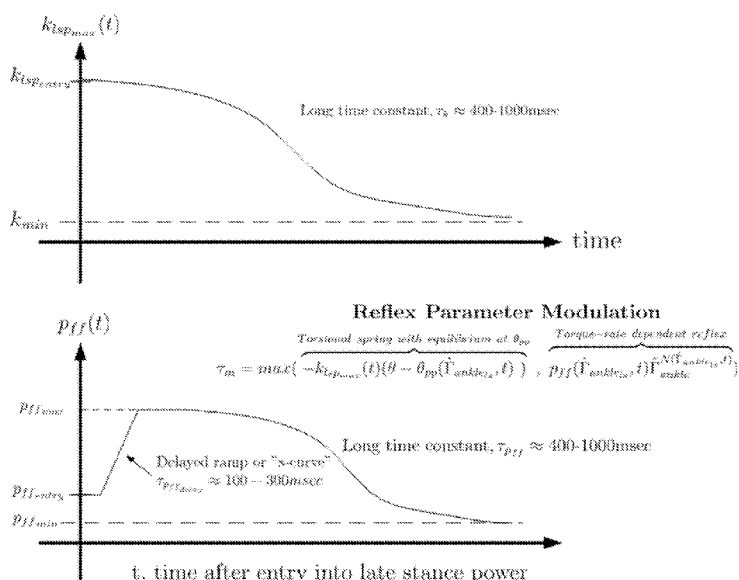


Fig. 24

(57) Abstract: A time-dependent decay behavior is incorporated into one or more joint actuator control parameters during operation of a lower-extremity, prosthetic, orthotic or exoskeleton device. These parameters may include joint equilibrium, joint impedance (e.g., stiffness, damping) and/or joint torque components (e.g., gain, exponent). The decay behavior may be exponential, linear, piecewise, or may conform to any other suitable function. Embodiments presented herein are used in a control system that emulates biological muscle-tendon reflex response providing for a natural walking experience. Further, joint impedance may depend on an angular rate of the joint. Such a relationship between angular rate and joint impedance may assist a wearer in carrying out certain activities, such as standing up and ascending a ladder.



(88) Date of publication of the international search report:

10 April 2014

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2013/045356**A. CLASSIFICATION OF SUBJECT MATTER****A61F 2/60(2006.01)i, A61F 2/62(2006.01)i, A61F 2/50(2006.01)i**

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

A61F 2/60; A61F 2/64; A61F 2/70; A61F 2/80; A61F 2/48; A61F 2/62; A61F 2/50

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) & Keywords: orthosis, prosthesis, artificial, exoskeleton, ankle, knee, leg, actuator, sensor, controller, joint impedance, joint equilibrium, torque

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2010-0174384 A1 (HERR, H. M. et al.) 8 July 2010 See abstract; claim 1,13; paragraphs [0031], [0054], [0058], [0087], [0268], [0305]-[0307]; and figures 17A,19A-19B.	1-3,19-21,28,33,38
A	US 6755870 B1 (BIEDERMANN, L. et al.) 29 June 2004 See abstract; claim 1; column 2, lines 30-48, lines 53-63; column 3, lines 8-29, lines 38-43; and figures 1-3(b).	1-3,19-21,28,33,38
A	US 2004-0193286 A1 (GRUNDEI, H.) 30 September 2004 See abstract; claim 1; paragraphs [0029]-[0033]; and figures 1-2.	1-3,19-21,28,33,38
A	WO 2004-017872 A1 (VICTHOM HUMAN BIONIC INC.) 4 March 2004 See abstract; claim 1; page 4, lines 15-20; page 5, lines 18-27; page 10, lines 17-28; page 11, lines 5-12; and figures 1,2,10,14.	1-3,19-21,28,33,38
A	US 2011-0098828 A1 (BALBONI, A. et al.) 28 April 2011. See abstract; claim 1; paragraphs [0012]-[0015], [0163]-[0172]; and figures 2-3.	1-3,19-21,28,33,38



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

05 February 2014 (05.02.2014)

Date of mailing of the international search report

06 February 2014 (06.02.2014)

Name and mailing address of the ISA/KR

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INTERNATIONAL SEARCH REPORTInternational application No.
PCT/US2013/045356**Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)**

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☒ Claims Nos.: 22-27,29-32,34-37,39
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
See Supplemental Box.
3. ☒ Claims Nos.: 4-18,22-26,29-32,34-37,39
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of any additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

Box No. II

Claims 22-26, 29-32, 34-37, 39 are worded in reference to the device of any one of the preceding claims. However, a method has been worded in claim 19. As claims 22-26, 29-32, 34-37, 39 do not clearly define the matter for which protection is sought, this claims do not meet the requirements of PCT Article 6.

Claim 27 is unclear, because it refers to multiple dependent claim 26 which does not comply with PCT Rule 6.4(a).

INTERNATIONAL SEARCH REPORT

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International application No.

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