

# Autonomous Robots

## Disambiguation of Human Intent Through Control Space Selection

--Manuscript Draft--

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<b>Abstract:</b>	<p>Assistive shared-control robots have the potential to transform the lives of millions of people afflicted with severe motor impairments as a result of spinal cord or brain injuries. The effectiveness and usefulness of shared-control robots is closely related to their ability to infer the user's needs and intentions and is often a limiting factor for providing appropriate assistance quickly, confidently and accurately. The contributions of this paper are three-fold: first, we propose a goal disambiguation algorithm which enhances the intent inference and assistive capabilities of a shared-control assistive robotic arm. Second, we introduce a novel intent inference algorithm that works in conjunction with the disambiguation scheme, inspired by dynamic field theory in which the time evolution of the probability distribution over goals is specified as a dynamical system. Third, we present a pilot human subject study to evaluate the efficacy of the disambiguation system. This study was performed with eight subjects. Our results suggest that (a) the disambiguation system has a greater utility value as the control interface becomes more limited and the task becomes more complex, (b) subjects demonstrated a diverse range of disambiguation request behavior with a greater concentration in the earlier parts of the trial and (c) there are no differences in the onset of robot assistance between different mode switching paradigms across tasks or across interfaces.</p>	
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4 This is pdfTeX, Version 3.14159265-2.6-1.40.16 (TeX Live 2015/W32TeX)
5 (preloaded format=pdflatex 2016.4.4)  1 DEC 2017 07:27
6 entering extended mode
7   restricted \writel8 enabled.
8   %&-line parsing enabled.
9 **./gopinathargallauro2017.tex
10 (./gopinathargallauro2017.tex
11 LaTeX2e <2016/03/31>
12 Babel <3.9q> and hyphenation patterns for 81 language(s) loaded.
13 (c:/TeXLive/2015/texmf-dist/tex/latex/base/fix-cm.sty
14 Package: fix-cm 2015/01/14 v1.1t fixes to LaTeX
15 (c:/TeXLive/2015/texmf-dist/tex/latex/base/tslenc.def
16 File: tslenc.def 2001/06/05 v3.0e (jks/car/fm) Standard LaTeX file
17 )) (./svjour3.cls
18 Document Class: svjour3 2007/05/08 v3.2
19 LaTeX document class for Springer journals
20 (c:/TeXLive/2015/texmf-dist/tex/latex/base/fleqn.clo
21 File: fleqn.clo 2015/03/31 v1.1i Standard LaTeX option (flush left
22 equations)
23 \mathindent=\dimen102
24 Applying: [2015/01/01] Make \[ robust on input line 50.
25 LaTeX Info: Redefining \[ on input line 51.
26 Already applied: [0000/00/00] Make \[ robust on input line 62.
27 Applying: [2015/01/01] Make \] robust on input line 74.
28 LaTeX Info: Redefining \] on input line 75.
29 Already applied: [0000/00/00] Make \] robust on input line 83.
30 )
31 Class Springer-SVJour3 Info: extra/valid Springer sub-package (-> *.clo)
32 (Springer-SVJour3) not found in option list of \documentclass
33 (Springer-SVJour3) - autoactivating "global" style.
34 (./svglov3.clo
35 File: svglov3.clo 2009/12/18 v3.2 style option for standardised journals
36 SVJour Class option: svglov3.clo for standardised journals
37 )
38 LaTeX Font Info: Redefining math symbol \Gamma on input line 147.
39 LaTeX Font Info: Redefining math symbol \Delta on input line 148.
40 LaTeX Font Info: Redefining math symbol \Theta on input line 149.
41 LaTeX Font Info: Redefining math symbol \Lambda on input line 150.
42 LaTeX Font Info: Redefining math symbol \Xi on input line 151.
43 LaTeX Font Info: Redefining math symbol \Pi on input line 152.
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46 LaTeX Font Info: Redefining math symbol \Phi on input line 155.
47 LaTeX Font Info: Redefining math symbol \Psi on input line 156.
48 LaTeX Font Info: Redefining math symbol \Omega on input line 157.
49 \logodepth=\dimen103
50 \headerboxheight=\dimen104
51 \betweenumberspace=\dimen105
52 \aftertext=\dimen106
53 \headlineindent=\dimen107
54 \c@inst=\count79
55 \c@auth=\count80
56 \instindent=\dimen108
57 \authrun=\box26
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2
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4 \authorrunning=\toks14
5 \titrun=\box27
6 \titlerunning=\toks15
7 \combirun=\box28
8 \c@lastpage=\count81
9 \rubricwidth=\dimen109
10 \c@section=\count82
11 \c@subsection=\count83
12 \c@subsubsection=\count84
13 \c@paragraph=\count85
14 \c@subparagraph=\count86
15 \spthmsep=\dimen110
16 \c@theorem=\count87
17 \c@case=\count88
18 \c@conjecture=\count89
19 \c@corollary=\count90
20 \c@definition=\count91
21 \c@example=\count92
22 \c@exercise=\count93
23 \c@lemma=\count94
24 \c@note=\count95
25 \c@problem=\count96
26 \c@property=\count97
27 \c@proposition=\count98
28 \c@question=\count99
29 \c@solution=\count100
30 \c@remark=\count101
31 \c@figure=\count102
32 \c@table=\count103
33 \abovecaptionskip=\skip41
34 \belowcaptionskip=\skip42
35 \figcapgap=\dimen111
36 \tabcapgap=\dimen112
37 \figgap=\dimen113
38 \bibindent=\dimen114
39 \@tempcntc=\count104
40 ) (c:/TeXLive/2015/texmf-dist/tex/latex/graphics/graphicx.sty
41 Package: graphicx 2014/10/28 v1.0g Enhanced LaTeX Graphics (DPC,SPQR)
42 (c:/TeXLive/2015/texmf-dist/tex/latex/graphics/keyval.sty
43 Package: keyval 2014/10/28 v1.15 key=value parser (DPC)
44 \KV@toks@=\toks16
45 ) (c:/TeXLive/2015/texmf-dist/tex/latex/graphics/graphics.sty
46 Package: graphics 2016/01/03 v1.0q Standard LaTeX Graphics (DPC,SPQR)
47 (c:/TeXLive/2015/texmf-dist/tex/latex/graphics/trig.sty
48 Package: trig 2016/01/03 v1.10 sin cos tan (DPC)
49 ) (c:/TeXLive/2015/texmf-dist/tex/latex/latexconfig/graphics.cfg
50 File: graphics.cfg 2010/04/23 v1.9 graphics configuration of TeX Live
51 )
52 Package graphics Info: Driver file: pdftex.def on input line 95.
53 (c:/TeXLive/2015/texmf-dist/tex/latex/pdftex-def/pdftex.def
54 File: pdftex.def 2011/05/27 v0.06d Graphics/color for pdfTeX
55 (c:/TeXLive/2015/texmf-dist/tex/generic/oberdiek/infwarerr.sty
56 Package: infwarerr 2010/04/08 v1.3 Providing info/warning/error messages
57 (HO)
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4 ) (c:/TeXLive/2015/texmf-dist/tex/generic/oberdiek/ltxcmds.sty
5 Package: ltxcmds 2011/11/09 v1.22 LaTeX kernel commands for general use
6 (HO)
7 )
8 \Gread@gobject=\count105
9 ))
10 \Gin@req@height=\dimen115
11 \Gin@req@width=\dimen116
12 ) (c:/TeXLive/2015/texmf-dist/tex/latex/amsfonts/amssymb.sty
13 Package: amssymb 2013/01/14 v3.01 AMS font symbols
14 (c:/TeXLive/2015/texmf-dist/tex/latex/amsfonts/amsfonts.sty
15 Package: amsfonts 2013/01/14 v3.01 Basic AMSFonts support
16 \@emptytoks=\toks17
17 \symAMSa=\mathgroup4
18 \symAMSb=\mathgroup5
19 LaTeX Font Info: Overwriting math alphabet '\mathfrak' in version
20 'bold'
21 (Font)
22 U/euf/m/n --> U/euf/b/n on input line 106.
23 )) (c:/TeXLive/2015/texmf-dist/tex/latex/amsmath/amsmath.sty
24 Package: amsmath 2016/03/10 v2.15b AMS math features
25 \@mathmargin=\skip43
26 For additional information on amsmath, use the '?' option.
27 (c:/TeXLive/2015/texmf-dist/tex/latex/amsmath/amstext.sty
28 Package: amstext 2000/06/29 v2.01 AMS text
29 (c:/TeXLive/2015/texmf-dist/tex/latex/amsmath/amsgen.sty
30 File: amsgen.sty 1999/11/30 v2.0 generic functions
31 \@emptytoks=\toks18
32 \ex@=\dimen117
33 )) (c:/TeXLive/2015/texmf-dist/tex/latex/amsmath/amsbsy.sty
34 Package: amsbsy 1999/11/29 v1.2d Bold Symbols
35 \pmbraise@=\dimen118
36 ) (c:/TeXLive/2015/texmf-dist/tex/latex/amsmath/amsopn.sty
37 Package: amsopn 2016/03/08 v2.02 operator names
38 )
39 \inf@bad=\count106
40 LaTeX Info: Redefining \frac on input line 199.
41 \uproot@=\count107
42 \leftroot@=\count108
43 LaTeX Info: Redefining \overline on input line 297.
44 \classnum@=\count109
45 \DOTSCASE@=\count110
46 LaTeX Info: Redefining \ldots on input line 394.
47 LaTeX Info: Redefining \dots on input line 397.
48 LaTeX Info: Redefining \cdots on input line 518.
49 \Mathstrutbox@=\box29
50 \strutbox@=\box30
51 \big@size=\dimen119
52 LaTeX Font Info: Redefining font encoding OML on input line 634.
53 LaTeX Font Info: Redefining font encoding OMS on input line 635.
54
55
56 Package amsmath Warning: Unable to redefine math accent \vec.
57
58
59 \macc@depth=\count111
60 \c@MaxMatrixCols=\count112
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2
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4 \dotsspace@=\muskip10
5 \c@parentequation=\count113
6 \dspbrk@lvl=\count114
7 \tag@help=\toks19
8 \row@=\count115
9 \column@=\count116
10 \maxfields@=\count117
11 \andhelp@=\toks20
12 \eqnshift@=\dimen120
13 \alignsep@=\dimen121
14 \tagshift@=\dimen122
15 \tagwidth@=\dimen123
16 \totwidth@=\dimen124
17 \lineht@=\dimen125
18 \@envbody=\toks21
19 \multlinegap=\skip44
20 \multlinetaggap=\skip45
21 \mathdisplay@stack=\toks22
22 LaTeX Info: Redefining \[ on input line 2739.
23 LaTeX Info: Redefining \] on input line 2740.
24 ) (c:/TeXLive/2015/texmf-dist/tex/latex/base/latexsym.sty
25 Package: latexsym 1998/08/17 v2.2e Standard LaTeX package (lasy symbols)
26 \symlasy=\mathgroup6
27 LaTeX Font Info: Overwriting symbol font `lasy' in version `bold'
28 (Font) U/lasy/m/n --> U/lasy/b/n on input line 52.
29 ) (c:/TeXLive/2015/texmf-dist/tex/latex/float/float.sty
30 Package: float 2001/11/08 v1.3d Float enhancements (AL)
31 \c@float@type=\count118
32 \float@exts=\toks23
33 \float@box=\box31
34 \@float@everytoks=\toks24
35 \@floatcapt=\box32
36 ) (c:/TeXLive/2015/texmf-dist/tex/latex/graphics/epsfig.sty
37 Package: epsfig 1999/02/16 v1.7a (e)psfig emulation (SPQR)
38 \epsfxsize=\dimen126
39 \epsfysize=\dimen127
40 ) (c:/TeXLive/2015/texmf-dist/tex/latex/subfigure/subfigure.sty
41 Package: subfigure 2002/03/15 v2.1.5 subfigure package
42 \subfigtopskip=\skip46
43 \subfigcapskip=\skip47
44 \subfigcaptopadj=\dimen128
45 \subfigbottomskip=\skip48
46 \subfigcapmargin=\dimen129
47 \subfiglabelskip=\skip49
48 \c@subfigure=\count119
49 \c@lofdepth=\count120
50 \c@subtable=\count121
51 \c@lotdepth=\count122
52 *****
53 * Local config file subfigure.cfg used *
54 *****
55 (c:/TeXLive/2015/texmf-dist/tex/latex/subfigure/subfigure.cfg)
56 \subfig@top=\skip50
57 \subfig@bottom=\skip51
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1
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4 ) (c:/TeXLive/2015/texmf-dist/tex/latex/mathtools/mathtools.sty
5 Package: mathtools 2015/11/12 v1.18 mathematical typesetting tools
6 (c:/TeXLive/2015/texmf-dist/tex/latex/tools/calc.sty
7 Package: calc 2014/10/28 v4.3 Infix arithmetic (KKT,FJ)
8 \calc@Acount=\count123
9 \calc@Bcount=\count124
10 \calc@Adimen=\dimen130
11 \calc@Bdimen=\dimen131
12 \calc@Askip=\skip52
13 \calc@Bskip=\skip53
14 LaTeX Info: Redefining \setlength on input line 80.
15 LaTeX Info: Redefining \addtolength on input line 81.
16 \calc@Ccount=\count125
17 \calc@Cskip=\skip54
18 ) (c:/TeXLive/2015/texmf-dist/tex/latex/mathtools/mhsetup.sty
19 Package: mhsetup 2010/01/21 v1.2a programming setup (MH)
20 )
21 LaTeX Info: Thecontrolsequence\('isalreadyrobust on input line 129.
22 LaTeX Info: Thecontrolsequence\)'isalreadyrobust on input line 129.
23 LaTeX Info: Thecontrolsequence\['isalreadyrobust on input line 129.
24 LaTeX Info: Thecontrolsequence\]'isalreadyrobust on input line 129.
25 \g_MT_multlinerow_int=\count126
26 \l_MT_multwidth_dim=\dimen132
27 \origjot=\skip55
28 \l_MT_shortvdotswithinadjustabove_dim=\dimen133
29 \l_MT_shortvdotswithinadjustbelow_dim=\dimen134
30 \l_MT_above_intertext_sep=\dimen135
31 \l_MT_below_intertext_sep=\dimen136
32 \l_MT_above_shortintertext_sep=\dimen137
33 \l_MT_below_shortintertext_sep=\dimen138
34 ) (c:/TeXLive/2015/texmf-dist/tex/latex/bbm-macros/bbm.sty
35 Package: bbm 1999/03/15 V 1.2 provides fonts for set symbols - TH
36 LaTeX Font Info: Overwriting math alphabet '\mathbbm' in version
37 'bold'
38 (Font) U/bbm/m/n --> U/bbm/bx/n on input line 33.
39 LaTeX Font Info: Overwriting math alphabet '\mathbbmss' in version
40 'bold'
41 (Font) U/bbmss/m/n --> U/bbmss/bx/n on input line 35.
42 ) (c:/TeXLive/2015/texmf-dist/tex/latex/lipsum/lipsum.sty
43 Package: lipsum 2014/07/27 v1.3 150 paragraphs of Lorem Ipsum dummy text
44 \c@lips@count=\count127
45 ) (c:/TeXLive/2015/texmf-dist/tex/latex/adjustbox/adjustbox.sty
46 Package: adjustbox 2012/05/21 v1.0 Adjusting TeX boxes (trim, clip, ...)
47 (c:/TeXLive/2015/texmf-dist/tex/latex/xkeyval/xkeyval.sty
48 Package: xkeyval 2014/12/03 v2.7a package option processing (HA)
49 (c:/TeXLive/2015/texmf-dist/tex/generic/xkeyval/xkeyval.tex
50 (c:/TeXLive/2015/te
51 xmf-dist/tex/generic/xkeyval/xkvutils.tex
52 \XKV@toks=\toks25
53 \XKV@tempa@toks=\toks26
54 )
55 \XKV@depth=\count128
56 File: xkeyval.tex 2014/12/03 v2.7a key=value parser (HA)
57 )) (c:/TeXLive/2015/texmf-dist/tex/latex/adjustbox/adjcalc.sty
58
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3
4 Package: adjcalc 2012/05/16 v1.1 Provides advanced setlength with
5 multiple back
6 -ends (calc, etex, pgfmath)
7 ) (c:/TeXLive/2015/texmf-dist/tex/latex/adjustbox/trimclip.sty
8 Package: trimclip 2012/05/16 v1.0 Trim and clip general TeX material
9 (c:/TeXLive/2015/texmf-dist/tex/latex/collectbox/collectbox.sty
10 Package: collectbox 2012/05/17 v0.4b Collect macro arguments as boxes
11 \collectedbox=\box33
12 )
13 \tc@llx=\dimen139
14 \tc@lly=\dimen140
15 \tc@urx=\dimen141
16 \tc@ury=\dimen142
17 Package trimclip Info: Using driver 'tc-pdftex.def'.
18 (c:/TeXLive/2015/texmf-dist/tex/latex/adjustbox/tc-pdftex.def
19 File: tc-pdftex.def 2012/05/13 v1.0 Clipping driver for pdftex
20 ))
21 \adjbox@Width=\dimen143
22 \adjbox@Height=\dimen144
23 \adjbox@Depth=\dimen145
24 \adjbox@Totalheight=\dimen146
25 (c:/TeXLive/2015/texmf-dist/tex/latex/ifoddpage/ifoddpage.sty
26 Package: ifoddpage 2011/09/13 v1.0 Conditionals for odd/even page
27 detection
28 \c@checkoddpage=\count129
29 ) (c:/TeXLive/2015/texmf-dist/tex/latex/varwidth/varwidth.sty
30 Package: varwidth 2009/03/30 ver 0.92; Variable-width minipages
31 \@vwid@box=\box34
32 \sift@deathcycles=\count130
33 \@vwid@loff=\dimen147
34 \@vwid@roff=\dimen148
35 )) (c:/TeXLive/2015/texmf-dist/tex/generic/ulem/ulem.sty
36 \UL@box=\box35
37 \UL@hyphenbox=\box36
38 \UL@skip=\skip56
39 \UL@hook=\toks27
40 \UL@height=\dimen149
41 \UL@pe=\count131
42 \UL@pixel=\dimen150
43 \ULC@box=\box37
44 Package: ulem 2012/05/18
45 \ULdepth=\dimen151
46 ) (c:/TeXLive/2015/texmf-dist/tex/latex/wrapfig/wrapfig.sty
47 \wrapoverhang=\dimen152
48 \WF@size=\dimen153
49 \c@WF@wrappedlines=\count132
50 \WF@box=\box38
51 \WF@everypar=\toks28
52 Package: wrapfig 2003/01/31 v 3.6
53 ) (c:/TeXLive/2015/texmf-dist/tex/latex/multirow/multirow.sty
54 \bigstrutjot=\dimen154
55 ) (c:/TeXLive/2015/texmf-dist/tex/latex/preprint/balance.sty
56 Package: balance 1999/02/23 4.3 (PWD)
57 \oldvsize=\dimen155
58
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) (c:/TeXLive/2015/texmf-dist/tex/latex/graphics/color.sty
Package: color 2016/01/03 v1.1b Standard LaTeX Color (DPC)
(c:/TeXLive/2015/texmf-dist/tex/latex/latexconfig/color.cfg
File: color.cfg 2007/01/18 v1.5 color configuration of teTeX/TeXLive
)
Package color Info: Driver file: pdftex.def on input line 143.
) (c:/TeXLive/2015/texmf-dist/tex/latex/url/url.sty
\Ulmuskip=\muskip11
Package: url 2013/09/16 ver 3.4 Verb mode for urls, etc.
) (./breakcites.sty) (c:/TeXLive/2015/texmf-
dist/tex/latex/microtype/microtype.
sty
Package: microtype 2013/05/23 v2.5a Micro-typographical refinements (RS)
\MT@toks=\toks29
\MT@count=\count133
LaTeX Info: Redefining \textls on input line 766.
\MT@outer@kern=\dimen156
LaTeX Info: Redefining \textmicrotypecontext on input line 1285.
\MT@listname@count=\count134
(c:/TeXLive/2015/texmf-dist/tex/latex/microtype/microtype-pdftex.def
File: microtype-pdftex.def 2013/05/23 v2.5a Definitions specific to
pdftex (RS)

LaTeX Info: Redefining \lsstyle on input line 915.
LaTeX Info: Redefining \slig on input line 915.
\MT@outer@space=\skip57
)
Package microtype Info: Loading configuration file microtype.cfg.
(c:/TeXLive/2015/texmf-dist/tex/latex/microtype/microtype.cfg
File: microtype.cfg 2013/05/23 v2.5a microtype main configuration file
(RS)
! Extra \else.
\XKV@wh@list ...r \expandafter \XKV@wh@list \else
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1.64 }

I'm ignoring this; it doesn't match any \if.

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\XKV@wh@list ...r \expandafter \XKV@wh@list \else
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\XKV@wh@list ...r \expandafter \XKV@wh@list \else
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5 ! Extra \else.
6 \XKV@wh@list ...r \expandafter \XKV@wh@list \else
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8 \e...
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11 I'm ignoring this; it doesn't match any \if.
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13 ! Extra \else.
14 \XKV@wh@list ...r \expandafter \XKV@wh@list \else
15                                     \def #3{#6}\expandafter
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21 ! Extra \else.
22 \XKV@wh@list ...r \expandafter \XKV@wh@list \else
23                                     \def #3{#6}\expandafter
24 \e...
25 1.71      }
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27 I'm ignoring this; it doesn't match any \if.
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29 ! Extra \else.
30 \XKV@wh@list ...r \expandafter \XKV@wh@list \else
31                                     \def #3{#6}\expandafter
32 \e...
33 1.71      }
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35 I'm ignoring this; it doesn't match any \if.
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37 ! Extra \else.
38 \XKV@wh@list ...r \expandafter \XKV@wh@list \else
39                                     \def #3{#6}\expandafter
40 \e...
41 1.71      }
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45 ! Extra \else.
46 \XKV@wh@list ...r \expandafter \XKV@wh@list \else
47                                     \def #3{#6}\expandafter
48 \e...
49 1.71      }
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51 I'm ignoring this; it doesn't match any \if.
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53 ! Extra \else.
54 \XKV@wh@list ...r \expandafter \XKV@wh@list \else
55                                     \def #3{#6}\expandafter
56 \e...
57 1.71      }
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59 I'm ignoring this; it doesn't match any \if.
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61 ! Extra \else.
62 \XKV@wh@list ...r \expandafter \XKV@wh@list \else
63                                     \def #3{#6}\expandafter
64 \e...
65 1.71      }

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5 I'm ignoring this; it doesn't match any \if.
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7 ! Extra \else.
8 \XKV@wh@list ...r \expandafter \XKV@wh@list \else
9 \def #3{#6}\expandafter
10 \e...
11 1.81 }
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13 I'm ignoring this; it doesn't match any \if.
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15 ! Extra \else.
16 \XKV@wh@list ...r \expandafter \XKV@wh@list \else
17 \def #3{#6}\expandafter
18 \e...
19 1.81 }
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21 I'm ignoring this; it doesn't match any \if.
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23 ! Extra \else.
24 \XKV@wh@list ...r \expandafter \XKV@wh@list \else
25 \def #3{#6}\expandafter
26 \e...
27 1.81 }
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29 I'm ignoring this; it doesn't match any \if.
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31 ! Extra \else.
32 \XKV@wh@list ...r \expandafter \XKV@wh@list \else
33 \def #3{#6}\expandafter
34 \e...
35 1.81 }
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37 I'm ignoring this; it doesn't match any \if.
38
39 ! Extra \else.
40 \XKV@wh@list ...r \expandafter \XKV@wh@list \else
41 \def #3{#6}\expandafter
42 \e...
43 1.81 }
44
45 I'm ignoring this; it doesn't match any \if.
46
47 ! Extra \else.
48 \XKV@wh@list ...r \expandafter \XKV@wh@list \else
49 \def #3{#6}\expandafter
50 \e...
51 1.86 }
52
53 I'm ignoring this; it doesn't match any \if.
54
55 ! Extra \else.
56 \XKV@wh@list ...r \expandafter \XKV@wh@list \else
57 \def #3{#6}\expandafter
58 \e...
59 1.86 }
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5                                     \def #3{#6}\expandafter
6 \e...
7 1.86      }
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9 I'm ignoring this; it doesn't match any \if.
10
11 ! Extra \else.
12 \XKV@wh@list ...r \expandafter \XKV@wh@list \else
13                                     \def #3{#6}\expandafter
14 \e...
15 1.86      }
16
17 I'm ignoring this; it doesn't match any \if.
18
19 ! Extra \else.
20 \XKV@wh@list ...r \expandafter \XKV@wh@list \else
21                                     \def #3{#6}\expandafter
22 \e...
23 1.86      }
24
25 I'm ignoring this; it doesn't match any \if.
26
27 ! Extra \else.
28 \XKV@wh@list ...r \expandafter \XKV@wh@list \else
29                                     \def #3{#6}\expandafter
30 \e...
31 1.86      }
32
33 I'm ignoring this; it doesn't match any \if.
34
35 ! Extra \else.
36 \XKV@wh@list ...r \expandafter \XKV@wh@list \else
37                                     \def #3{#6}\expandafter
38 \e...
39 1.89      { font = */*/*/*/* }
40
41 I'm ignoring this; it doesn't match any \if.
42
43 ! Extra \else.
44 \XKV@wh@list ...r \expandafter \XKV@wh@list \else
45                                     \def #3{#6}\expandafter
46 \e...
47 1.89      { font = */*/*/*/* }
48
49 I'm ignoring this; it doesn't match any \if.
50
51 ! Extra \else.
52 \XKV@wh@list ...r \expandafter \XKV@wh@list \else
53                                     \def #3{#6}\expandafter
54 \e...
55 1.89      { font = */*/*/*/* }
56
57 I'm ignoring this; it doesn't match any \if.
58
59 I'm ignoring this; it doesn't match any \if.
60
61
62
63
64
65

```

```

1
2
3
4 ! Extra \else.
5 \XKV@wh@list ...r \expandafter \XKV@wh@list \else
6 \def #3{#6}\expandafter
7 \e...
8 1.89 { font = */*/*/*/ }
9
10 I'm ignoring this; it doesn't match any \if.
11
12 ! Extra \else.
13 \XKV@wh@list ...r \expandafter \XKV@wh@list \else
14 \def #3{#6}\expandafter
15 \e...
16 1.89 { font = */*/*/*/ }
17
18 I'm ignoring this; it doesn't match any \if.
19
20
21 )) (./natbib.sty
22 Package: natbib 1998/07/14 6.8c (PWD)
23 \bibhang=\skip58
24 \bibsep=\skip59
25 LaTeX Info: Redefining \cite on input line 467.
26 \c@NAT@ctr=\count135
27 ) (c:/TeXLive/2015/texmf-dist/tex/latex/algorithms/algorithm.sty
28 Package: algorithm 2009/08/24 v0.1 Document Style `algorithm' - floating
29 enviro
30 nment
31 (c:/TeXLive/2015/texmf-dist/tex/latex/base/ifthen.sty
32 Package: ifthen 2014/09/29 v1.1c Standard LaTeX ifthen package (DPC)
33 )
34 \@float@every@algorithm=\toks30
35 \c@algorithm=\count136
36 ) (c:/TeXLive/2015/texmf-dist/tex/latex/algorithms/algorithmic.sty
37 Package: algorithmic 2009/08/24 v0.1 Document Style `algorithmic'
38 \c@ALC@unique=\count137
39 \c@ALC@line=\count138
40 \c@ALC@rem=\count139
41 \c@ALC@depth=\count140
42 \ALC@tlm=\skip60
43 \algorithmicindent=\skip61
44 ) (c:/TeXLive/2015/texmf-dist/tex/latex/breqn/breqn.sty
45 (c:/TeXLive/2015/texmf-
46 dist/tex/latex/l3kernel/expl3.sty
47 Package: expl3 2016/03/28 v6468 L3 programming layer (loader)
48 (c:/TeXLive/2015/texmf-dist/tex/latex/l3kernel/expl3-code.tex
49 Package: expl3 2016/03/28 v6468 L3 programming layer (code)
50 L3 Module: l3bootstrap 2016/02/12 v6412 L3 Bootstrap code
51 L3 Module: l3names 2016/03/11 v6433 L3 Namespace for primitives
52 L3 Module: l3basics 2015/11/22 v6315 L3 Basic definitions
53 L3 Module: l3expan 2015/09/10 v5983 L3 Argument expansion
54 L3 Module: l3ttl 2016/03/26 v6465 L3 Token lists
55 L3 Module: l3str 2016/03/24 v6441 L3 Strings
56 L3 Module: l3seq 2015/08/05 v5777 L3 Sequences and stacks
57 L3 Module: l3int 2016/03/24 v6441 L3 Integers
58 \c_max_int=\count141
59
60
61
62
63
64
65

```

```
1
2
3
4 \l_tmpa_int=\count142
5 \l_tmpb_int=\count143
6 \g_tmpa_int=\count144
7 \g_tmpb_int=\count145
8 L3 Module: l3quark 2015/08/17 v5855 L3 Quarks
9 L3 Module: l3prg 2015/11/01 v6216 L3 Control structures
10 \g__prg_map_int=\count146
11 L3 Module: l3clist 2015/09/02 v5901 L3 Comma separated lists
12 L3 Module: l3token 2016/03/26 v6465 L3 Experimental token manipulation
13 L3 Module: l3prop 2016/01/05 v6366 L3 Property lists
14 L3 Module: l3msg 2016/03/26 v6464 L3 Messages
15 L3 Module: l3file 2016/03/25 v6458 L3 File and I/O operations
16 \l_iow_line_count_int=\count147
17 \l_iow_target_count_int=\count148
18 \l_iow_current_line_int=\count149
19 \l_iow_current_word_int=\count150
20 \l_iow_current_indentation_int=\count151
21 L3 Module: l3skip 2016/01/05 v6366 L3 Dimensions and skips
22 \c_zero_dim=\dimen157
23 \c_max_dim=\dimen158
24 \l_tmpa_dim=\dimen159
25 \l_tmpb_dim=\dimen160
26 \g_tmpa_dim=\dimen161
27 \g_tmpb_dim=\dimen162
28 \c_zero_skip=\skip62
29 \c_max_skip=\skip63
30 \l_tmpa_skip=\skip64
31 \l_tmpb_skip=\skip65
32 \g_tmpa_skip=\skip66
33 \g_tmpb_skip=\skip67
34 \c_zero_muskip=\muskip12
35 \c_max_muskip=\muskip13
36 \l_tmpa_muskip=\muskip14
37 \l_tmpb_muskip=\muskip15
38 \g_tmpa_muskip=\muskip16
39 \g_tmpb_muskip=\muskip17
40 L3 Module: l3keys 2015/11/17 v6284 L3 Key-value interfaces
41 \g__keyval_level_int=\count152
42 \l_keys_choice_int=\count153
43 L3 Module: l3fp 2016/03/26 v6465 L3 Floating points
44 \c__fp_leading_shift_int=\count154
45 \c__fp_middle_shift_int=\count155
46 \c__fp_trailing_shift_int=\count156
47 \c__fp_big_leading_shift_int=\count157
48 \c__fp_big_middle_shift_int=\count158
49 \c__fp_big_trailing_shift_int=\count159
50 \c__fp_Bigg_leading_shift_int=\count160
51 \c__fp_Bigg_middle_shift_int=\count161
52 \c__fp_Bigg_trailing_shift_int=\count162
53 L3 Module: l3box 2015/08/09 v5822 L3 Experimental boxes
54 \c_empty_box=\box39
55 \l_tmpa_box=\box40
56 \l_tmpb_box=\box41
57 \g_tmpa_box=\box42
58
59
60
61
62
63
64
65
```

```

1
2
3
4 \g_tmpb_box=\box43
5 L3 Module: l3coffins 2016/03/24 v6440 L3 Coffin code layer
6 \l__coffin_internal_box=\box44
7 \l__coffin_internal_dim=\dimen163
8 \l__coffin_offset_x_dim=\dimen164
9 \l__coffin_offset_y_dim=\dimen165
10 \l__coffin_x_dim=\dimen166
11 \l__coffin_y_dim=\dimen167
12 \l__coffin_x_prime_dim=\dimen168
13 \l__coffin_y_prime_dim=\dimen169
14 \c_empty_coffin=\box45
15 \l__coffin_aligned_coffin=\box46
16 \l__coffin_aligned_internal_coffin=\box47
17 \l_tmpa_coffin=\box48
18 \l_tmpb_coffin=\box49
19 \l__coffin_display_coffin=\box50
20 \l__coffin_display_coord_coffin=\box51
21 \l__coffin_display_pole_coffin=\box52
22 \l__coffin_display_offset_dim=\dimen170
23 \l__coffin_display_x_dim=\dimen171
24 \l__coffin_display_y_dim=\dimen172
25 L3 Module: l3color 2014/08/23 v5354 L3 Experimental color support
26 L3 Module: l3sys 2015/09/25 v6087 L3 Experimental system/runtime
27 functions
28 L3 Module: l3candidates 2016/03/25 v6456 L3 Experimental additions to
29 l3kernel
30 \l__box_top_dim=\dimen173
31 \l__box_bottom_dim=\dimen174
32 \l__box_left_dim=\dimen175
33 \l__box_right_dim=\dimen176
34 \l__box_top_new_dim=\dimen177
35 \l__box_bottom_new_dim=\dimen178
36 \l__box_left_new_dim=\dimen179
37 \l__box_right_new_dim=\dimen180
38 \l__box_internal_box=\box53
39 \l__coffin_bounding_shift_dim=\dimen181
40 \l__coffin_left_corner_dim=\dimen182
41 \l__coffin_right_corner_dim=\dimen183
42 \l__coffin_bottom_corner_dim=\dimen184
43 \l__coffin_top_corner_dim=\dimen185
44 \l__coffin_scaled_total_height_dim=\dimen186
45 \l__coffin_scaled_width_dim=\dimen187
46 L3 Module: l3luatex 2016/03/26 v6465 L3 Experimental LuaTeX-specific
47 functions
48 ) (c:/TeXLive/2015/texmf-dist/tex/latex/l3kernel/l3pdfmode.def
49 File: l3pdfmode.def 2016/03/26 v6465 L3 Experimental driver: PDF mode
50 \l__driver_color_stack_int=\count163
51 ))
52 Package: breqn 2015/08/11 v0.98d Breaking equations
53 (c:/TeXLive/2015/texmf-dist/tex/latex/breqn/flexisym.sty
54 Package: flexisym 2015/08/11 v0.98d Make math characters macros
55 LaTeX Info: Redefining \textprime on input line 299.
56 LaTeX Info: Redefining \not on input line 357.
57 (c:/TeXLive/2015/texmf-dist/tex/latex/breqn/cmbase.sym
58
59
60
61
62
63
64
65

```

```

File: cmbase.sym 2007/12/19 v0.92
LaTeX Info: Redefining \hbar on input line 324.
LaTeX Info: Redefining \surd on input line 326.
LaTeX Info: Redefining \angle on input line 334.
LaTeX Info: Redefining \neg on input line 335.
LaTeX Info: Redefining \mapsto on input line 336.
LaTeX Info: Redefining \cong on input line 337.
LaTeX Info: Redefining \notin on input line 340.
LaTeX Info: Redefining \rightleftharpoons on input line 341.
LaTeX Info: Redefining \doteq on input line 342.
LaTeX Info: Redefining \hookrightarrow on input line 343.
LaTeX Info: Redefining \hookleftarrow on input line 344.
LaTeX Info: Redefining \bowtie on input line 345.
LaTeX Info: Redefining \models on input line 346.
LaTeX Info: Redefining \Longrightarrow on input line 347.
LaTeX Info: Redefining \longrightarrow on input line 348.
LaTeX Info: Redefining \Longleftarrow on input line 349.
LaTeX Info: Redefining \longleftarrow on input line 350.
LaTeX Info: Redefining \longmapsto on input line 351.
LaTeX Info: Redefining \longlefttrightarrow on input line 352.
LaTeX Info: Redefining \Longlefttrightarrow on input line 353.
LaTeX Info: Redefining \cdots on input line 357.
LaTeX Info: Redefining \vdots on input line 360.
LaTeX Info: Redefining \ddots on input line 365.
) (c:/TeXLive/2015/texmf-dist/tex/latex/breqn/mathstyle.sty
Package: mathstyle 2015/08/11 v0.98d Tracking mathstyle implicitly
LaTeX Info: Redefining \displaystyle on input line 93.
LaTeX Info: Redefining \textstyle on input line 95.
LaTeX Info: Redefining \scriptstyle on input line 97.
LaTeX Info: Redefining \scriptscriptstyle on input line 99.
LaTeX Info: Redefining \genfrac on input line 145.
))
\inf@bad=\count164
\maxint=\count165
\listwidth=\dimen188
\eqnumsep=\dimen189
\eqmargin=\dimen190
\eqlinespacing=\skip68
\eqlineskip=\skip69
\eqlineskiplimit=\dimen191
\eqbinoffset=\muskip18
\eqdelimoffset=\muskip19
\eqindentstep=\dimen192
\eqstyle=\toks31
\eqbreakdepth=\count166
\eqinterlinepenalty=\count167
\intereqpenalty=\count168
\intereqskip=\skip70
\prerelpenalty=\count169
\prebinoppenalty=\count170
\Dmedmuskip=\muskip20
\Dthickmuskip=\muskip21
\eqleftskip=\skip71
\eqrightskip=\skip72

```



```

\eq@vspan=\skip73
\eq@binoffset=\muskip22
\EQ@box=\box54
\EQ@copy=\box55
\EQ@numbox=\box56
\eq@wdNum=\dimen193
\GRP@numbox=\box57
\grp@wdNum=\dimen194
\eq@lines=\count171
\eq@curline=\count172
\eq@badness=\count173
\EQ@vims=\count174
\eq@dp=\dimen195
\eq@wdL=\dimen196
\eq@wdT=\dimen197
\eq@wdMin=\dimen198
\grp@wdL=\dimen199
\grp@wdR=\dimen256
\grp@wdT=\dimen257
\eq@wdRmax=\dimen258
\eq@firstht=\dimen259
\eq@wdCond=\dimen260
\eq@indentstep=\dimen261
\eq@linewidth=\dimen262
\grp@linewidth=\dimen263
\eq@hshift=\dimen264
\eq@given@sidespace=\dimen265
\eq@final@linecount=\count175
\eq@wdR=\dimen266
\EQ@continue=\toks32
\lr@level=\count176
\GRP@queue=\toks33
\GRP@box=\box58
\GRP@wholebox=\box59
\darraycolsep=\skip74
\cur@row=\count177
\cur@col=\count178
\conditionsep=\skip75
) (c:/TeXLive/2015/texmf-dist/tex/latex/footmisc/footmisc.sty
Package: footmisc 2011/06/06 v5.5b a miscellany of footnote facilities
\FN@temptoken=\toks34
\footnotemargin=\dimen267
\c@pp@next@reset=\count179
Package footmisc Info: Declaring symbol style bringhurst on input line
855.
Package footmisc Info: Declaring symbol style chicago on input line 863.
Package footmisc Info: Declaring symbol style wiley on input line 872.
Package footmisc Info: Declaring symbol style lamport-robust on input
line 883.

Package footmisc Info: Declaring symbol style lamport* on input line 903.
Package footmisc Info: Declaring symbol style lamport*-robust on input
line 924
.

```

```

1
2
3
4 ) (./gopinathargallauro2017.aux)
5 \openout1 = `gopinathargallauro2017.aux'.
6
7 LaTeX Font Info:    Checking defaults for OML/cmm/m/it on input line 89.
8 LaTeX Font Info:    ... okay on input line 89.
9 LaTeX Font Info:    Checking defaults for T1/cmr/m/n on input line 89.
10 LaTeX Font Info:    ... okay on input line 89.
11 LaTeX Font Info:    Checking defaults for OT1/cmr/m/n on input line 89.
12 LaTeX Font Info:    ... okay on input line 89.
13 LaTeX Font Info:    Checking defaults for OMS/cmsy/m/n on input line 89.
14 LaTeX Font Info:    ... okay on input line 89.
15 LaTeX Font Info:    Checking defaults for OMX/cmex/m/n on input line 89.
16 LaTeX Font Info:    ... okay on input line 89.
17 LaTeX Font Info:    Checking defaults for U/cmr/m/n on input line 89.
18 LaTeX Font Info:    ... okay on input line 89.
19 LaTeX Font Info:    Checking defaults for TS1/cmr/m/n on input line 89.
20 LaTeX Font Info:    ... okay on input line 89.
21
22 (c:/TeXLive/2015/texmf-dist/tex/context/base/supp-pdf.mkii
23 [Loading MPS to PDF converter (version 2006.09.02).]
24 \scratchcounter=\count180
25 \scratchdimen=\dimen268
26 \scratchbox=\box60
27 \nofMPsegments=\count181
28 \nofMParguments=\count182
29 \everyMPshowfont=\toks35
30 \MPscratchCnt=\count183
31 \MPscratchDim=\dimen269
32 \MPnumerator=\count184
33 \makeMPintoPDFobject=\count185
34 \everyMPtoPDFconversion=\toks36
35 ) (c:/TeXLive/2015/texmf-dist/tex/generic/oberdiek/pdfdoccmds.sty
36 Package: pdfdoccmds 2011/11/29 v0.20 Utility functions of pdfTeX for
37 LuaTeX (HO
38 )
39 (c:/TeXLive/2015/texmf-dist/tex/generic/oberdiek/ifluatex.sty
40 Package: ifluatex 2010/03/01 v1.3 Provides the ifluatex switch (HO)
41 Package ifluatex Info: LuaTeX not detected.
42 ) (c:/TeXLive/2015/texmf-dist/tex/generic/oberdiek/ifpdf.sty
43 Package: ifpdf 2011/01/30 v2.3 Provides the ifpdf switch (HO)
44 Package ifpdf Info: pdfTeX in PDF mode is detected.
45 )
46 Package pdfdoccmds Info: LuaTeX not detected.
47 Package pdfdoccmds Info: \pdf@primitive is available.
48 Package pdfdoccmds Info: \pdf@ifprimitive is available.
49 Package pdfdoccmds Info: \pdfdraftmode found.
50 ) (c:/TeXLive/2015/texmf-dist/tex/latex/oberdiek/epstopdf-base.sty
51 Package: epstopdf-base 2010/02/09 v2.5 Base part for package epstopdf
52 (c:/TeXLive/2015/texmf-dist/tex/latex/oberdiek/grfext.sty
53 Package: grfext 2010/08/19 v1.1 Manage graphics extensions (HO)
54 (c:/TeXLive/2015/texmf-dist/tex/generic/oberdiek/kvdefinekeys.sty
55 Package: kvdefinekeys 2011/04/07 v1.3 Define keys (HO)
56 )) (c:/TeXLive/2015/texmf-dist/tex/latex/oberdiek/kvoptions.sty
57 Package: kvoptions 2011/06/30 v3.11 Key value format for package options
58 (HO)
59
60
61
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```

```

(c:/TeXLive/2015/texmf-dist/tex/generic/oberdiek/kvsetkeys.sty
Package: kvsetkeys 2012/04/25 v1.16 Key value parser (HO)
(c:/TeXLive/2015/texmf-dist/tex/generic/oberdiek/etexcmds.sty
Package: etexcmds 2011/02/16 v1.5 Avoid name clashes with e-TeX commands
(HO)
Package etexcmds Info: Could not find \expanded.
(etexcmds)          That can mean that you are not using pdfTeX 1.50
or
(etexcmds)          that some package has redefined \expanded.
(etexcmds)          In the latter case, load this package earlier.
)))
Package grfext Info: Graphics extension search list:
(grfext)
[.png,.pdf,.jpg,.mps,.jpeg,.jbig2,.jb2,.PNG,.PDF,.JPG,.JPE
G,.JBIG2,.JB2,.eps]
(grfext)          \AppendGraphicsExtensions on input line 452.
(c:/TeXLive/2015/texmf-dist/tex/latex/latexconfig/epstopdf-sys.cfg
File: epstopdf-sys.cfg 2010/07/13 v1.3 Configuration of (r)epstopdf for
TeX Liv
e
))
LaTeX Info: Redefining \microtypecontext on input line 89.
Package microtype Info: Generating PDF output.
Package microtype Info: Character protrusion enabled (level 2).
Package microtype Info: Using default protrusion set `alltext'.
Package microtype Info: Automatic font expansion enabled (level 2),
(microtype)          stretch: 20, shrink: 20, step: 1, non-selected.
Package microtype Info: Using default expansion set `basictext'.
Package microtype Info: No adjustment of tracking.
Package microtype Info: No adjustment of interword spacing.
Package microtype Info: No adjustment of character kerning.
(c:/TeXLive/2015/texmf-dist/tex/latex/microtype/mt-cmr.cfg
File: mt-cmr.cfg 2013/05/19 v2.2 microtype config. file: Computer Modern
Roman
(RS)
)
LaTeX Font Info:      Try loading font information for U+msa on input line
125.
(c:/TeXLive/2015/texmf-dist/tex/latex/amsfonts/umsa.fd
File: umsa.fd 2013/01/14 v3.01 AMS symbols A
) (c:/TeXLive/2015/texmf-dist/tex/latex/microtype/mt-msa.cfg
File: mt-msa.cfg 2006/02/04 v1.1 microtype config. file: AMS symbols (a)
(RS)
)
LaTeX Font Info:      Try loading font information for U+msb on input line
125.
(c:/TeXLive/2015/texmf-dist/tex/latex/amsfonts/umsb.fd
File: umsb.fd 2013/01/14 v3.01 AMS symbols B
) (c:/TeXLive/2015/texmf-dist/tex/latex/microtype/mt-msb.cfg
File: mt-msb.cfg 2005/06/01 v1.0 microtype config. file: AMS symbols (b)
(RS)
)
LaTeX Font Info:      Font shape `U/lasy/b/n' in size <7> not available

```

(Font) Font shape ``U/lasy/m/n'` tried instead on input line 125.

LaTeX Font Info: Font shape ``U/lasy/b/n'` in size `<5>` not available

(Font) Font shape ``U/lasy/m/n'` tried instead on input line 125.

LaTeX Font Info: Calculating math sizes for size `<8.5>` on input line 125.

Package natbib Warning: Citation ``laplante1992assistive'` on page 1 undefined on input line 140.

Package natbib Warning: Citation ``scherer1996outcomes'` on page 1 undefined on input line 140.

Package natbib Warning: Citation ``huete2012personal'` on page 1 undefined on input line 140.

Package natbib Warning: Citation ``simpson2008tooth'` on page 1 undefined on input line 142.

Package natbib Warning: Citation ``nuttin2002selection'` on page 1 undefined on input line 142.

Package epstopdf Info: Source file: `<Fig1.eps>`

(epstopdf) date: 2017-12-01 07:26:49

(epstopdf) size: 3011293 bytes

(epstopdf) Output file: `<Fig1-eps-converted-to.pdf>`

(epstopdf) date: 2017-12-01 07:27:09

(epstopdf) size: 1698620 bytes

(epstopdf) Command: `<repstopdf --outfile=Fig1-eps-converted-to.pdf>`

Fig1.eps>

(epstopdf) `\includegraphics` on input line 145.

Package epstopdf Info: Output file is already up to date.

`<Fig1-eps-converted-to.pdf, id=1, 1659.19875pt x 1281.78876pt>`

File: Fig1-eps-converted-to.pdf Graphic file (type pdf)

`<use Fig1-eps-converted-to.pdf>`

Package pdftex.def Info: Fig1-eps-converted-to.pdf used on input line 145.

(pdftex.def) Requested size: 420.75302pt x 325.04265pt.

LaTeX Font Info: Font shape ``U/lasy/b/n'` in size `<8.5>` not available

(Font) Font shape ``U/lasy/m/n'` tried instead on input line 146.

LaTeX Font Info: Font shape ``U/lasy/b/n'` in size `<5.94997>` not available

(Font) Font shape 'U/lasy/m/n' tried instead on input line 146.  
LaTeX Font Info: Font shape 'U/lasy/b/n' in size <4.25> not available  
(Font) Font shape 'U/lasy/m/n' tried instead on input line 146.

Package natbib Warning: Citation 'eftring1999technical' on page 1 undefined on input line 149.

[1{c:/TeXLive/2015/texmf-var/fonts/map/pdftex/updmap/pdftex.map}

]

Package natbib Warning: Citation 'gopinath2017mode' on page 2 undefined on input line 155.

Package epstopdf Info: Source file: <Fig2.eps>  
(epstopdf) date: 2017-12-01 07:26:49  
(epstopdf) size: 125295 bytes  
(epstopdf) Output file: <Fig2-eps-converted-to.pdf>  
(epstopdf) date: 2017-12-01 07:27:14  
(epstopdf) size: 126768 bytes  
(epstopdf) Command: <repstopdf --outfile=Fig2-eps-converted-to.pdf  
Fig2.eps>  
(epstopdf) \includegraphics on input line 163.

Package epstopdf Info: Output file is already uptodate.  
<Fig2-eps-converted-to.pdf, id=17, 663.47874pt x 478.78876pt>  
File: Fig2-eps-converted-to.pdf Graphic file (type pdf)  
<use Fig2-eps-converted-to.pdf>  
Package pdftex.def Info: Fig2-eps-converted-to.pdf used on input line 163.  
(pdftex.def) Requested size: 173.25302pt x 125.02275pt.

Package natbib Warning: Citation 'philips2007adaptive' on page 2 undefined on input line 179.

Package natbib Warning: Citation 'demeester2008user' on page 2 undefined on input line 179.

Package natbib Warning: Citation 'gopinath2017human' on page 2 undefined on input line 179.

Package natbib Warning: Citation 'muelling2017autonomy' on page 2 undefined on

input line 179.

Package natbib Warning: Citation `tsui2011want' on page 2 undefined on input line 179.

Package natbib Warning: Citation `kim2010relationship' on page 2 undefined on input line 179.

Package natbib Warning: Citation `kim2012autonomy' on page 2 undefined on input line 179.

Package natbib Warning: Citation `driessen2005collaborative' on page 2 undefined on input line 179.

Package natbib Warning: Citation `downey2016blending' on page 2 undefined on input line 179.

Package natbib Warning: Citation `storms2014blending' on page 2 undefined on input line 179.

Package natbib Warning: Citation `muelling2017autonomy' on page 2 undefined on input line 179.

[2]  
Underfull \vbox (badness 10000) has occurred while \output is active []

Package natbib Warning: Citation `herlant2016assistive' on page 3 undefined on input line 181.

Package natbib Warning: Citation `pilarski2012dynamic' on page 3 undefined on input line 181.

Package natbib Warning: Citation `liu2016goal' on page 3 undefined on input line 183.

Package natbib Warning: Citation `choi2008laser' on page 3 undefined on  
input 1  
ine 183.

Package natbib Warning: Citation `baker2007goal' on page 3 undefined on  
input 1  
ine 183.

Package natbib Warning: Citation `baker2009action' on page 3 undefined on  
input  
line 183.

Package natbib Warning: Citation `taha2011pomdp' on page 3 undefined on  
input 1  
ine 183.

Package natbib Warning: Citation `dragan2012assistive' on page 3  
undefined on i  
nput line 183.

Package natbib Warning: Citation `gopinath2017human' on page 3 undefined  
on inp  
ut line 183.

Underfull \vbox (badness 2828) has occurred while \output is active []

[3 <./Fig1-eps-converted-to.pdf> <./Fig2-eps-converted-to.pdf>]

Package natbib Warning: Citation `sadigh2016information' on page 4  
undefined on  
input line 186.

Package natbib Warning: Citation `sadigh2016planning' on page 4 undefined  
on in  
put line 186.

Package natbib Warning: Citation `atanasov2014information' on page 4  
undefined  
on input line 186.

Package natbib Warning: Citation `miller2016ergodic' on page 4 undefined  
on inp  
ut line 187.

Package natbib Warning: Citation `miller2013trajectory' on page 4  
undefined on  
input line 187.

Package natbib Warning: Citation `tomasello2007shared' on page 4  
undefined on i  
nput line 189.

Package natbib Warning: Citation `tomasello2010gap' on page 4 undefined  
on inpu  
t line 189.

Package natbib Warning: Citation `sorokin2010people' on page 4 undefined  
on in  
ut line 189.

Package natbib Warning: Citation `goodfellow2010help' on page 4 undefined  
on in  
put line 189.

Package natbib Warning: Citation `dragan2013legibility' on page 4  
undefined on  
input line 189.

Package natbib Warning: Citation `holladay2014legible' on page 4  
undefined on i  
nput line 189.

Package natbib Warning: Citation `gopinath2017mode' on page 4 undefined  
on inpu  
t line 189.

Underfull \vbox (badness 2426) has occurred while \output is active []  
[4]

Package natbib Warning: Citation `kelley2008understanding' on page 5  
undefined  
on input line 211.

Package natbib Warning: Citation `wang2013probabilistic' on page 5  
undefined on  
input line 211.



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5 Package epstopdf Info: Source file: <Fig3.eps>
6 (epstopdf) date: 2017-12-01 07:26:49
7 (epstopdf) size: 49232 bytes
8 (epstopdf) Output file: <Fig3-eps-converted-to.pdf>
9 (epstopdf) date: 2017-12-01 07:27:18
10 (epstopdf) size: 39004 bytes
11 (epstopdf) Command: <repstopdf --outfile=Fig3-eps-converted-
12 to.pdf
13 Fig3.eps>
14 (epstopdf) \includegraphics on input line 215.
15 Package epstopdf Info: Output file is already uptodate.
16 <Fig3-eps-converted-to.pdf, id=40, 478.78876pt x 438.63875pt>
17 File: Fig3-eps-converted-to.pdf Graphic file (type pdf)
18 <use Fig3-eps-converted-to.pdf>
19 Package pdftex.def Info: Fig3-eps-converted-to.pdf used on input line
20 215.
21 (pdftex.def) Requested size: 238.96417pt x 218.92393pt.
22 [5 <./Fig3-eps-converted-to.pdf>]
23 Package epstopdf Info: Source file: <Fig4.eps>
24 (epstopdf) date: 2017-12-01 07:26:49
25 (epstopdf) size: 411428 bytes
26 (epstopdf) Output file: <Fig4-eps-converted-to.pdf>
27 (epstopdf) date: 2017-12-01 07:27:23
28 (epstopdf) size: 798504 bytes
29 (epstopdf) Command: <repstopdf --outfile=Fig4-eps-converted-
30 to.pdf
31 Fig4.eps>
32 (epstopdf) \includegraphics on input line 287.
33 Package epstopdf Info: Output file is already uptodate.
34 <Fig4-eps-converted-to.pdf, id=55, 1314.9125pt x 736.7525pt>
35 File: Fig4-eps-converted-to.pdf Graphic file (type pdf)
36 <use Fig4-eps-converted-to.pdf>
37 Package pdftex.def Info: Fig4-eps-converted-to.pdf used on input line
38 287.
39 (pdftex.def) Requested size: 569.25363pt x 299.59726pt.
40
41 Package natbib Warning: Citation `gopinath2017mode' on page 6 undefined
42 on input line 288.
43
44 Package natbib Warning: Citation `gopinath2017mode' on page 6 undefined
45 on input line 288.
46
47 Package natbib Warning: Citation `gopinath2017mode' on page 6 undefined
48 on input line 323.
49
50 [6]
51 Underfull \vbox (badness 10000) has occurred while \output is active []
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Package natbib Warning: Citation `schoner2015dynamic' on page 7 undefined  
on in  
put line 332.

Package natbib Warning: Citation `amaril1977dynamics' on page 7 undefined  
on in  
ut line 335.

[7 <./Fig4-eps-converted-to.pdf>]

Package natbib Warning: Citation `wilson1973mathematical' on page 8  
undefined o  
n input line 340.

Package natbib Warning: Citation `schoner2008dynamical' on page 8  
undefined on  
input line 342.

Package natbib Warning: Citation `erlhagen2006dynamic' on page 8  
undefined on i  
nput line 343.

Package natbib Warning: Citation `erlhagen2014dynamic' on page 8  
undefined on i  
nput line 343.

Package natbib Warning: Citation `zibner2011dynamic' on page 8 undefined  
on in  
ut line 343.

Package natbib Warning: Citation `schoner1995dynamics' on page 8  
undefined on i  
nput line 343.

Package natbib Warning: Citation `faubel2008learning' on page 8 undefined  
on in  
put line 343.

LaTeX Font Info: Try loading font information for U+bbm on input line  
357.  
(c:/TeXLive/2015/texmf-dist/tex/latex/bbm-macros/ubbm.fd  
File: ubbm.fd 1999/03/15 V 1.2 Font definition for bbm font - TH  
) [8]

Package natbib Warning: Citation `argall2009survey' on page 9 undefined  
on inpu

t line 380.

Package natbib Warning: Citation `schaal1997learning' on page 9 undefined  
on input line 380.

Package natbib Warning: Citation `hsu2002randomized' on page 9 undefined  
on input line 380.

Package natbib Warning: Citation `ratliff2009chomp' on page 9 undefined  
on input line 380.

Package natbib Warning: Citation `rimon1992exact' on page 9 undefined on  
input line 380.

Package natbib Warning: Citation `tanner2003nonholonomic' on page 9  
undefined on input line 380.

LaTeX Font Warning: Font shape `U/bbm/m/n' in size <8.5> not available  
(Font) size <8> substituted on input line 395.

LaTeX Font Warning: Font shape `U/bbm/m/n' in size <4.25> not available  
(Font) size <5> substituted on input line 395.

Package natbib Warning: Citation `khatib1986real' on page 9 undefined on  
input line 397.

Package epstopdf Info: Source file: <Fig5.eps>  
(epstopdf) date: 2017-12-01 07:26:49  
(epstopdf) size: 310438 bytes  
(epstopdf) Output file: <Fig5-eps-converted-to.pdf>  
(epstopdf) date: 2017-12-01 07:27:28  
(epstopdf) size: 83448 bytes  
(epstopdf) Command: <repstopdf --outfile=Fig5-eps-converted-  
to.pdf  
Fig5.eps>  
(epstopdf) \includegraphics on input line 412.  
Package epstopdf Info: Output file is already up to date.  
<Fig5-eps-converted-to.pdf, id=74, 1144.275pt x 418.56375pt>  
File: Fig5-eps-converted-to.pdf Graphic file (type pdf)  
<use Fig5-eps-converted-to.pdf>

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4 Package pdftex.def Info: Fig5-eps-converted-to.pdf used on input line
5 412.
6 (pdftex.def) Requested size: 238.9604pt x 93.20837pt.
7 Package epstopdf Info: Source file: <Fig6.eps>
8 (epstopdf) date: 2017-12-01 07:26:50
9 (epstopdf) size: 6490402 bytes
10 (epstopdf) Output file: <Fig6-eps-converted-to.pdf>
11 (epstopdf) date: 2017-12-01 07:27:34
12 (epstopdf) size: 337764 bytes
13 (epstopdf) Command: <repstopdf --outfile=Fig6-eps-converted-
14 to.pdf
15 Fig6.eps>
16 (epstopdf) \includegraphics on input line 418.
17 Package epstopdf Info: Output file is already uptodate.
18 <Fig6-eps-converted-to.pdf, id=75, 1927.2pt x 542.025pt>
19 File: Fig6-eps-converted-to.pdf Graphic file (type pdf)
20 <use Fig6-eps-converted-to.pdf>
21 Package pdftex.def Info: Fig6-eps-converted-to.pdf used on input line
22 418.
23 (pdftex.def) Requested size: 495.0pt x 139.21115pt.
24 [9 <./Fig5-eps-converted-to.pdf>]
25 Package epstopdf Info: Source file: <Fig7.eps>
26 (epstopdf) date: 2017-12-01 07:26:50
27 (epstopdf) size: 34226 bytes
28 (epstopdf) Output file: <Fig7-eps-converted-to.pdf>
29 (epstopdf) date: 2017-12-01 07:27:38
30 (epstopdf) size: 10330 bytes
31 (epstopdf) Command: <repstopdf --outfile=Fig7-eps-converted-
32 to.pdf
33 Fig7.eps>
34 (epstopdf) \includegraphics on input line 451.
35 Package epstopdf Info: Output file is already uptodate.
36 <Fig7-eps-converted-to.pdf, id=82, 682.55pt x 371.3875pt>
37 File: Fig7-eps-converted-to.pdf Graphic file (type pdf)
38 <use Fig7-eps-converted-to.pdf>
39 Package pdftex.def Info: Fig7-eps-converted-to.pdf used on input line
40 451.
41 (pdftex.def) Requested size: 450.45181pt x 245.0995pt.
42
43 Overfull \hbox (1.40538pt too wide) in paragraph at lines 461--462
44 $[]$ \OT1/cmr/m/n/10 (-20) : In the sec-ond phase of train-ing, the
45 blending-
46 []
47
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50 [10 <./Fig6-eps-converted-to.pdf>]
51 Package epstopdf Info: Source file: <Fig8.eps>
52 (epstopdf) date: 2017-12-01 07:26:50
53 (epstopdf) size: 193852 bytes
54 (epstopdf) Output file: <Fig8-eps-converted-to.pdf>
55 (epstopdf) date: 2017-12-01 07:27:42
56 (epstopdf) size: 215174 bytes
57 (epstopdf) Command: <repstopdf --outfile=Fig8-eps-converted-
58 to.pdf
59 Fig8.eps>
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4      (epstopdf)                \includegraphics on input line 485.
5 Package epstopdf Info: Output file is already uptodate.
6 <Fig8-eps-converted-to.pdf, id=92, 716.6775pt x 541.02126pt>
7 File: Fig8-eps-converted-to.pdf Graphic file (type pdf)
8 <use Fig8-eps-converted-to.pdf>
9 Package pdftex.def Info: Fig8-eps-converted-to.pdf used on input line
10 485.
11 (pdftex.def)                Requested size: 415.79819pt x 313.8916pt.
12 [11 <./Fig7-eps-converted-to.pdf>]
13 Package epstopdf Info: Source file: <Fig9.eps>
14 (epstopdf)                date: 2017-12-01 07:26:50
15 (epstopdf)                size: 2099967 bytes
16 (epstopdf)                Output file: <Fig9-eps-converted-to.pdf>
17 (epstopdf)                date: 2017-12-01 07:27:47
18 (epstopdf)                size: 157574 bytes
19 (epstopdf)                Command: <repstopdf --outfile=Fig9-eps-converted-
20 to.pdf
21 Fig9.eps>
22 (epstopdf)                \includegraphics on input line 519.
23 Package epstopdf Info: Output file is already uptodate.
24 <Fig9-eps-converted-to.pdf, id=104, 619.31375pt x 257.96375pt>
25 File: Fig9-eps-converted-to.pdf Graphic file (type pdf)
26 <use Fig9-eps-converted-to.pdf>
27 Package pdftex.def Info: Fig9-eps-converted-to.pdf used on input line
28 519.
29 (pdftex.def)                Requested size: 396.00151pt x 164.95451pt.
30 [12 <./Fig8-eps-converted-to.pdf>]
31 Package epstopdf Info: Source file: <Fig10.eps>
32 (epstopdf)                date: 2017-12-01 07:26:50
33 (epstopdf)                size: 28366 bytes
34 (epstopdf)                Output file: <Fig10-eps-converted-to.pdf>
35 (epstopdf)                date: 2017-12-01 07:27:51
36 (epstopdf)                size: 8842 bytes
37 (epstopdf)                Command: <repstopdf --outfile=Fig10-eps-converted-
38 to.pdf
39 Fig10.eps>
40 (epstopdf)                \includegraphics on input line 531.
41 Package epstopdf Info: Output file is already uptodate.
42 <Fig10-eps-converted-to.pdf, id=114, 619.31375pt x 447.6725pt>
43 File: Fig10-eps-converted-to.pdf Graphic file (type pdf)
44 <use Fig10-eps-converted-to.pdf>
45 Package pdftex.def Info: Fig10-eps-converted-to.pdf used on input line
46 531.
47 (pdftex.def)                Requested size: 238.96417pt x 172.73355pt.
48 [13 <./Fig9-eps-converted-to.pdf> <./Fig10-eps-converted-to.pdf>]
49 No file gopinathargallauro2017.bbl.
50
51
52
53 Package natbib Warning: There were undefined citations.
54
55
56 Package balance Warning: You have called \balance in second column
57 (balance)                Columns might not be balanced.
58
59
60 [14] (./gopinathargallauro2017.aux)
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53 Here is how much of TeX's memory you used:
54 14852 strings out of 493027
55 253889 string characters out of 6137679
56 425570 words of memory out of 5000000
57 17977 multiletter control sequences out of 15000+600000
58 24687 words of font info for 168 fonts, out of 8000000 for 9000
59 1141 hyphenation exceptions out of 8191
60
61
62
63
64
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38i,20n,51p,10404b,590s stack positions out of  
5000i,500n,10000p,200000b,80000s  
<c:/Users/asynch/.texlive20  
15/texmf-  
var/fonts/pk/ljfour/public/bbm/bbm10.600pk><c:/TeXLive/2015/texmf-dist  
/fonts/type1/public/amsfonts/cm/cmbsy10.pfb><c:/TeXLive/2015/texmf-  
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ype1/public/amsfonts/cm/cmbx10.pfb><c:/TeXLive/2015/texmf-  
dist/fonts/type1/publ  
ic/amsfonts/cm/cmbx12.pfb><c:/TeXLive/2015/texmf-  
dist/fonts/type1/public/amsfon  
ts/cm/cmbx8.pfb><c:/TeXLive/2015/texmf-  
dist/fonts/type1/public/amsfonts/cm/cmex  
10.pfb><c:/TeXLive/2015/texmf-  
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fb><c:/TeXLive/2015/texmf-  
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el/public/amsfonts/cm/cmsy8.pfb><c:/TeXLive/2015/texmf-  
dist/fonts/type1/public/  
amsfonts/cm/cmti10.pfb><c:/TeXLive/2015/texmf-  
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cm/cmti8.pfb><c:/TeXLive/2015/texmf-  
dist/fonts/type1/public/amsfonts/symbols/ms  
bm10.pfb>  
Output written on gopinathargallauro2017.pdf (14 pages, 3779043 bytes).  
PDF statistics:  
206 PDF objects out of 1000 (max. 8388607)  
131 compressed objects within 2 object streams  
0 named destinations out of 1000 (max. 500000)  
14387 words of extra memory for PDF output out of 14400 (max. 10000000)



**Biography – Deepak E. Gopinath**

Deepak E. Gopinath is a third-year doctoral student in the Mechanical Engineering Department at Northwestern University and works with Dr. Brenna Argall in the Assistive and Rehabilitation Robotics Laboratory at the Shirley Ryan AbilityLab in Chicago. He completed his B.Tech in Engineering Physics from IIT Bombay in 2007, after which he moved to Boston, USA to pursue a Professional Diploma in Music at Berklee College of Music majoring in Composition and Jazz Performance. Prior to coming to Northwestern, he completed an M.S in Music Technology at Georgia Tech under Dr. Gil Weinberg where he worked in field of Robotic Musicianship. His current research interests are in developing mathematical formalisms for shared-control architectures for assistive robotic manipulators and information theoretic approaches to characterize human-robot interaction.

## Bio-Dr. Brenna Argall

Brenna Argall is an Associate Professor of Electrical Engineering & Computer Science, Mechanical Engineering and Physical Medicine & Rehabilitation at Northwestern University. She is also a Faculty Research Scientist at the Shirley Ryan AbilityLab, the premier rehabilitation hospital in the United States. She is the director of the assistive & rehabilitation robotics laboratory (**argallab**). Her research lies in the intersection of robotics, machine learning and human rehabilitation. The mission of the **argallab** is to advance human ability by leveraging autonomy. Dr. Argall is a 2016 recipient of the NSF CAREER award, and her Ph.D. in Robotics (2009) was received from the Robotics Institute at Carnegie Mellon University, as well as her M.S in Robotics (2006) and B.S in Mathematics (2002). Prior to joining Northwestern, she was a postdoctoral fellow (2009-2011) at the École polytechnique fédérale de Lausanne (EPFL), and prior to graduate school she held a Computational Biology position at the National Institutes of Health (NIH).



