Autonomous Robots
Disambiguation of Human Intent Through Control Space Selection
--Manuscript Draft--

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Abstract: 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.

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	Rachel Holladay Massachusetts Institute of Technology

rhollada@mit.edu

```
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(preloaded format=pdflatex 2016.4.6)  1 DEC 2017 23:25
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Document Class: svjour3 2007/05/08 v3.2
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LaTeX Info: Redefining \] on input line 75.
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)
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(Springer-SVJour3)                not found in option list of \documentclass
(Springer-SVJour3)                - autoactivating "global" style.
(./svglov3.clo
File: svglov3.clo 2009/12/18 v3.2 style option for standardised journals
SVJour Class option: svglov3.clo for standardised journals
)
LaTeX Font Info:    Redeclaring math symbol \Gamma on input line 147.
LaTeX Font Info:    Redeclaring math symbol \Delta on input line 148.
LaTeX Font Info:    Redeclaring math symbol \Theta on input line 149.
LaTeX Font Info:    Redeclaring math symbol \Lambda on input line 150.
LaTeX Font Info:    Redeclaring math symbol \Xi on input line 151.
LaTeX Font Info:    Redeclaring math symbol \Pi on input line 152.
LaTeX Font Info:    Redeclaring math symbol \Sigma on input line 153.
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\betweenumberspace=\dimen105
\aftertext=\dimen106
\headlineindent=\dimen107
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\c@auth=\count80
\instindent=\dimen108
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\combirun=\box28
\c@lastpage=\count81
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\c@section=\count82
\c@subsection=\count83
\c@subsubsection=\count84
\c@paragraph=\count85
\c@subparagraph=\count86
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\c@case=\count88
\c@conjecture=\count89
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\c@definition=\count91
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\c@exercise=\count93
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\c@proposition=\count98
\c@question=\count99
\c@solution=\count100
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\c@figure=\count102
\c@table=\count103
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\belowcaptionskip=\skip42
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\tabcapgap=\dimen112
\figgap=\dimen113
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) (c:/TeXLive/2015/texmf-dist/tex/latex/natbib/natbib.sty
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\bibhang=\skip43
\bibsep=\skip44
LaTeX Info: Redefining \cite on input line 694.
\c@NAT@ctr=\count105
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Package: graphicx 2014/10/28 v1.0g Enhanced LaTeX Graphics (DPC,SPQR)
(c:/TeXLive/2015/texmf-dist/tex/latex/graphics/keyval.sty
Package: keyval 2014/10/28 v1.15 key=value parser (DPC)
\KV@toks@=\toks16
) (c:/TeXLive/2015/texmf-dist/tex/latex/graphics/graphics.sty
Package: graphics 2016/01/03 v1.0q Standard LaTeX Graphics (DPC,SPQR)
(c:/TeXLive/2015/texmf-dist/tex/latex/graphics/trig.sty
Package: trig 2016/01/03 v1.10 sin cos tan (DPC)
) (c:/TeXLive/2015/texmf-dist/tex/latex/latexconfig/graphics.cfg
File: graphics.cfg 2010/04/23 v1.9 graphics configuration of TeX Live
)
```

```
Package graphics Info: Driver file: pdftex.def on input line 95.
(c:/TeXLive/2015/texmf-dist/tex/latex/pdftex-def/pdftex.def
File: pdftex.def 2011/05/27 v0.06d Graphics/color for pdfTeX
(c:/TeXLive/2015/texmf-dist/tex/generic/oberdiek/infwarerr.sty
Package: infwarerr 2010/04/08 v1.3 Providing info/warning/error messages
(HO)
) (c:/TeXLive/2015/texmf-dist/tex/generic/oberdiek/ltxcmds.sty
Package: ltxcmds 2011/11/09 v1.22 LaTeX kernel commands for general use
(HO)
)
\Gread@gobject=\count106
))
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\Gin@req@width=\dimen116
) (c:/TeXLive/2015/texmf-dist/tex/latex/amsfonts/amssymb.sty
Package: amssymb 2013/01/14 v3.01 AMS font symbols
(c:/TeXLive/2015/texmf-dist/tex/latex/amsfonts/amsfonts.sty
Package: amsfonts 2013/01/14 v3.01 Basic AMSFonts support
\@emptytoks=\toks17
\symAMSa=\mathgroup4
\symAMSb=\mathgroup5
LaTeX Font Info:    Overwriting math alphabet `\mathfrak' in version
`bold'
(Font)                  U/euf/m/n --> U/euf/b/n on input line 106.
)) (c:/TeXLive/2015/texmf-dist/tex/latex/amsmath/amsmath.sty
Package: amsmath 2016/03/10 v2.15b AMS math features
\@mathmargin=\skip45
For additional information on amsmath, use the `?' option.
(c:/TeXLive/2015/texmf-dist/tex/latex/amsmath/amstext.sty
Package: amstext 2000/06/29 v2.01 AMS text
(c:/TeXLive/2015/texmf-dist/tex/latex/amsmath/amsgen.sty
File: amsgen.sty 1999/11/30 v2.0 generic functions
\@emptytoks=\toks18
\ex@=\dimen117
)) (c:/TeXLive/2015/texmf-dist/tex/latex/amsmath/amsbsy.sty
Package: amsbsy 1999/11/29 v1.2d Bold Symbols
\pmbraise@=\dimen118
) (c:/TeXLive/2015/texmf-dist/tex/latex/amsmath/amsopn.sty
Package: amsopn 2016/03/08 v2.02 operator names
)
\inf@bad=\count107
LaTeX Info: Redefining \frac on input line 199.
\uproot@=\count108
\leftroot@=\count109
LaTeX Info: Redefining \overline on input line 297.
\classnum@=\count110
\DOTSCASE@=\count111
LaTeX Info: Redefining \ldots on input line 394.
LaTeX Info: Redefining \dots on input line 397.
LaTeX Info: Redefining \cdots on input line 518.
\Mathstrutbox@=\box29
\strutbox@=\box30
\big@size=\dimen119
LaTeX Font Info:    Redeclaring font encoding OML on input line 634.
```

```
LaTeX Font Info:    Redeclaring font encoding OMS on input line 635.

Package amsmath Warning: Unable to redefine math accent \vec.

\macc@depth=\count112
\c@MaxMatrixCols=\count113
\dotsspace@=\muskip10
\c@parentequation=\count114
\dspbrk@lvl=\count115
\tag@help=\toks19
\row@=\count116
\column@=\count117
\maxfields@=\count118
\andhelp@=\toks20
\eqnshift@=\dimen120
\alignsep@=\dimen121
\tagshift@=\dimen122
\tagwidth@=\dimen123
\totwidth@=\dimen124
\lineht@=\dimen125
\@envbody=\toks21
\multlinegap=\skip46
\multlinetaggap=\skip47
\mathdisplay@stack=\toks22
LaTeX Info: Redefining \[ on input line 2739.
LaTeX Info: Redefining \] on input line 2740.
) (c:/TeXLive/2015/texmf-dist/tex/latex/base/latexsym.sty
Package: latexsym 1998/08/17 v2.2e Standard LaTeX package (lasy symbols)
\symlasy=\mathgroup6
LaTeX Font Info:    Overwriting symbol font `lasy' in version `bold'
(Font)                  U/lasy/m/n --> U/lasy/b/n on input line 52.
) (c:/TeXLive/2015/texmf-dist/tex/latex/float/float.sty
Package: float 2001/11/08 v1.3d Float enhancements (AL)
\c@float@type=\count119
\float@exts=\toks23
\float@box=\box31
\@float@everytoks=\toks24
\@floatcapt=\box32
) (c:/TeXLive/2015/texmf-dist/tex/latex/graphics/epsfig.sty
Package: epsfig 1999/02/16 v1.7a (e)psfig emulation (SPQR)
\epsfxsize=\dimen126
\epsfysize=\dimen127
) (c:/TeXLive/2015/texmf-dist/tex/latex/subfigure/subfigure.sty
Package: subfigure 2002/03/15 v2.1.5 subfigure package
\subfigtopskip=\skip48
\subfigcapskip=\skip49
\subfigcaptopadj=\dimen128
\subfigbottomskip=\skip50
\subfigcapmargin=\dimen129
\subfiglabelskip=\skip51
\c@subfigure=\count120
\c@lofdepth=\count121
\c@subtable=\count122
\c@lotdepth=\count123
```

```
*****************************************
* Local config file subfigure.cfg used *
*****************************************
(c:/TeXLive/2015/texmf-dist/tex/latex/subfigure/subfigure.cfg)
\subfig@top=\skip52
\subfig@bottom=\skip53
) (c:/TeXLive/2015/texmf-dist/tex/latex/mathtools/mathtools.sty
Package: mathtools 2015/11/12 v1.18 mathematical typesetting tools
(c:/TeXLive/2015/texmf-dist/tex/latex/tools/calc.sty
Package: calc 2014/10/28 v4.3 Infix arithmetic (KKT,FJ)
\calc@Acount=\count124
\calc@Bcount=\count125
\calc@Adimen=\dimen130
\calc@Bdimen=\dimen131
\calc@Askip=\skip54
\calc@Bskip=\skip55
LaTeX Info: Redefining \setlength on input line 80.
LaTeX Info: Redefining \addtolength on input line 81.
\calc@Ccount=\count126
\calc@Cskip=\skip56
) (c:/TeXLive/2015/texmf-dist/tex/latex/mathtools/mhsetup.sty
Package: mhsetup 2010/01/21 v1.2a programming setup (MH)
)
LaTeX Info: Thecontrolsequence`\('isalreadyrobust on input line 129.
LaTeX Info: Thecontrolsequence`\)'isalreadyrobust on input line 129.
LaTeX Info: Thecontrolsequence`\['isalreadyrobust on input line 129.
LaTeX Info: Thecontrolsequence`\]'isalreadyrobust on input line 129.
\g_MT_multlinerow_int=\count127
\l_MT_multwidth_dim=\dimen132
\origjot=\skip57
\l_MT_shortvdotswithinadjustabove_dim=\dimen133
\l_MT_shortvdotswithinadjustbelow_dim=\dimen134
\l_MT_above_intertext_sep=\dimen135
\l_MT_below_intertext_sep=\dimen136
\l_MT_above_shortintertext_sep=\dimen137
\l_MT_below_shortintertext_sep=\dimen138
) (c:/TeXLive/2015/texmf-dist/tex/latex/bbm-macros/bbm.sty
Package: bbm 1999/03/15 V 1.2 provides fonts for set symbols - TH
LaTeX Font Info:    Overwriting math alphabet `\mathbbm' in version
`bold'
(Font)                  U/bbm/m/n --> U/bbm/bx/n on input line 33.
LaTeX Font Info:    Overwriting math alphabet `\mathbbmss' in version
`bold'
(Font)                  U/bbmss/m/n --> U/bbmss/bx/n on input line 35.
) (c:/TeXLive/2015/texmf-dist/tex/latex/lipsum/lipsum.sty
Package: lipsum 2014/07/27 v1.3 150 paragraphs of Lorem Ipsum dummy text
\c@lips@count=\count128
) (c:/TeXLive/2015/texmf-dist/tex/latex/adjustbox/adjustbox.sty
Package: adjustbox 2012/05/21 v1.0 Adjusting TeX boxes (trim, clip, ...)
(c:/TeXLive/2015/texmf-dist/tex/latex/xkeyval/xkeyval.sty
Package: xkeyval 2014/12/03 v2.7a package option processing (HA)
(c:/TeXLive/2015/texmf-dist/tex/generic/xkeyval/xkeyval.tex
(c:/TeXLive/2015/te
xmf-dist/tex/generic/xkeyval/xkvutils.tex
```

```
\XKV@toks=\toks25
\XKV@tempa@toks=\toks26
)
\XKV@depth=\count129
File: xkeyval.tex 2014/12/03 v2.7a key=value parser (HA)
)) (c:/TeXLive/2015/texmf-dist/tex/latex/adjustbox/adjcalc.sty
Package: adjcalc 2012/05/16 v1.1 Provides advanced setlength with
multiple back
-ends (calc, etex, pgfmath)
) (c:/TeXLive/2015/texmf-dist/tex/latex/adjustbox/trimclip.sty
Package: trimclip 2012/05/16 v1.0 Trim and clip general TeX material
(c:/TeXLive/2015/texmf-dist/tex/latex/collectbox/collectbox.sty
Package: collectbox 2012/05/17 v0.4b Collect macro arguments as boxes
\collectedbox=\box33
)
\tc@llx=\dimen139
\tc@lly=\dimen140
\tc@urx=\dimen141
\tc@ury=\dimen142
Package trimclip Info: Using driver 'tc-pdftex.def'.
(c:/TeXLive/2015/texmf-dist/tex/latex/adjustbox/tc-pdftex.def
File: tc-pdftex.def 2012/05/13 v1.0 Clipping driver for pdftex
))
\adjbox@Width=\dimen143
\adjbox@Height=\dimen144
\adjbox@Depth=\dimen145
\adjbox@Totalheight=\dimen146
(c:/TeXLive/2015/texmf-dist/tex/latex/ifoddpage/ifoddpage.sty
Package: ifoddpage 2011/09/13 v1.0 Conditionals for odd/even page
detection
\c@checkoddpage=\count130
) (c:/TeXLive/2015/texmf-dist/tex/latex/varwidth/varwidth.sty
Package: varwidth 2009/03/30 ver 0.92;  Variable-width minipages
\@vwid@box=\box34
\sift@deathcycles=\count131
\@vwid@loff=\dimen147
\@vwid@roff=\dimen148
)) (c:/TeXLive/2015/texmf-dist/tex/generic/ulem/ulem.sty
\UL@box=\box35
\UL@hyphenbox=\box36
\UL@skip=\skip58
\UL@hook=\toks27
\UL@height=\dimen149
\UL@pe=\count132
\UL@pixel=\dimen150
\ULC@box=\box37
Package: ulem 2012/05/18
\ULdepth=\dimen151
) (c:/TeXLive/2015/texmf-dist/tex/latex/wrapfig/wrapfig.sty
\wrapoverhang=\dimen152
\WF@size=\dimen153
\c@WF@wrappedlines=\count133
\WF@box=\box38
\WF@everypar=\toks28
```

```
Package: wrapfig 2003/01/31  v 3.6
) (c:/TeXLive/2015/texmf-dist/tex/latex/multirow/multirow.sty
\bigstrutjot=\dimen154
) (c:/TeXLive/2015/texmf-dist/tex/latex/preprint/balance.sty
Package: balance 1999/02/23 4.3 (PWD)
\oldvsize=\dimen155
) (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.
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Package: url 2013/09/16  ver 3.4  Verb mode for urls, etc.
) (c:/TeXLive/2015/texmf-dist/tex/latex/microtype/microtype.sty
Package: microtype 2013/05/23 v2.5a Micro-typographical refinements (RS)
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\MT@count=\count134
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\MT@outer@kern=\dimen156
LaTeX Info: Redefining \textmicrotypecontext on input line 1285.
\MT@listname@count=\count135
(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 \lslig on input line 915.
\MT@outer@space=\skip59
)
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
                                              \def #3{#6}\expandafter
\e...
l.64    }

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

! Extra \else.
\XKV@wh@list ...r \expandafter \XKV@wh@list \else
                                              \def #3{#6}\expandafter
\e...
l.64    }

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

! Extra \else.
\XKV@wh@list ...r \expandafter \XKV@wh@list \else
```

```
                                                                 \def #3{#6}\expandafter
      \e...
      l.64     }

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

      ! Extra \else.
      \XKV@wh@list ...r \expandafter \XKV@wh@list \else
                                                                 \def #3{#6}\expandafter
      \e...
      l.64     }

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

      ! Extra \else.
      \XKV@wh@list ...r \expandafter \XKV@wh@list \else
                                                                 \def #3{#6}\expandafter
      \e...
      l.64     }

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

      ! Extra \else.
      \XKV@wh@list ...r \expandafter \XKV@wh@list \else
                                                                 \def #3{#6}\expandafter
      \e...
      l.71     }

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

      ! Extra \else.
      \XKV@wh@list ...r \expandafter \XKV@wh@list \else
                                                                 \def #3{#6}\expandafter
      \e...
      l.71     }

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

      ! Extra \else.
      \XKV@wh@list ...r \expandafter \XKV@wh@list \else
                                                                 \def #3{#6}\expandafter
      \e...
      l.71     }

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

      ! Extra \else.
      \XKV@wh@list ...r \expandafter \XKV@wh@list \else
                                                                 \def #3{#6}\expandafter
      \e...
      l.71     }

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

```
! Extra \else.
\XKV@wh@list ...r \expandafter \XKV@wh@list \else
                                            \def #3{#6}\expandafter
\e...
l.71     }

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

! Extra \else.
\XKV@wh@list ...r \expandafter \XKV@wh@list \else
                                            \def #3{#6}\expandafter
\e...
l.81     }

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

! Extra \else.
\XKV@wh@list ...r \expandafter \XKV@wh@list \else
                                            \def #3{#6}\expandafter
\e...
l.81     }

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

! Extra \else.
\XKV@wh@list ...r \expandafter \XKV@wh@list \else
                                            \def #3{#6}\expandafter
\e...
l.81     }

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

! Extra \else.
\XKV@wh@list ...r \expandafter \XKV@wh@list \else
                                            \def #3{#6}\expandafter
\e...
l.81     }

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

! Extra \else.
\XKV@wh@list ...r \expandafter \XKV@wh@list \else
                                            \def #3{#6}\expandafter
\e...
l.81     }

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

! Extra \else.
\XKV@wh@list ...r \expandafter \XKV@wh@list \else
                                            \def #3{#6}\expandafter
\e...
l.86     }
```

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

        ! Extra \else.
        \XKV@wh@list ...r \expandafter \XKV@wh@list \else
                                                    \def #3{#6}\expandafter
        \e...
        l.86    }


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

        ! Extra \else.
        \XKV@wh@list ...r \expandafter \XKV@wh@list \else
                                                    \def #3{#6}\expandafter
        \e...
        l.86    }


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

        ! Extra \else.
        \XKV@wh@list ...r \expandafter \XKV@wh@list \else
                                                    \def #3{#6}\expandafter
        \e...
        l.86    }


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

        ! Extra \else.
        \XKV@wh@list ...r \expandafter \XKV@wh@list \else
                                                    \def #3{#6}\expandafter
        \e...
        l.86    }


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

        ! Extra \else.
        \XKV@wh@list ...r \expandafter \XKV@wh@list \else
                                                    \def #3{#6}\expandafter
        \e...
        l.89    { font = */*/*/*/* }


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

        ! Extra \else.
        \XKV@wh@list ...r \expandafter \XKV@wh@list \else
                                                    \def #3{#6}\expandafter
        \e...
        l.89    { font = */*/*/*/* }


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

        ! Extra \else.
        \XKV@wh@list ...r \expandafter \XKV@wh@list \else
                                                    \def #3{#6}\expandafter
        \e...
```

```
l.89    { font = */*/*/*/* }

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

! Extra \else.
\XKV@wh@list ...r \expandafter \XKV@wh@list \else
                                            \def #3{#6}\expandafter
\e...
l.89    { font = */*/*/*/* }

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

! Extra \else.
\XKV@wh@list ...r \expandafter \XKV@wh@list \else
                                            \def #3{#6}\expandafter
\e...
l.89    { font = */*/*/*/* }

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

)) (c:/TeXLive/2015/texmf-dist/tex/latex/algorithms/algorithm.sty
Package: algorithm 2009/08/24 v0.1 Document Style `algorithm' - floating
enviro
nment
(c:/TeXLive/2015/texmf-dist/tex/latex/base/ifthen.sty
Package: ifthen 2014/09/29 v1.1c Standard LaTeX ifthen package (DPC)
)
\@float@every@algorithm=\toks30
\c@algorithm=\count136
) (c:/TeXLive/2015/texmf-dist/tex/latex/algorithms/algorithmic.sty
Package: algorithmic 2009/08/24 v0.1 Document Style `algorithmic'
\c@ALC@unique=\count137
\c@ALC@line=\count138
\c@ALC@rem=\count139
\c@ALC@depth=\count140
\ALC@tlm=\skip60
\algorithmicindent=\skip61
) (c:/TeXLive/2015/texmf-dist/tex/latex/breqn/breqn.sty
(c:/TeXLive/2015/texmf-
dist/tex/latex/l3kernel/expl3.sty
Package: expl3 2016/03/28 v6468 L3 programming layer (loader)
(c:/TeXLive/2015/texmf-dist/tex/latex/l3kernel/expl3-code.tex
Package: expl3 2016/03/28 v6468 L3 programming layer (code)
L3 Module: l3bootstrap 2016/02/12 v6412 L3 Bootstrap code
L3 Module: l3names 2016/03/11 v6433 L3 Namespace for primitives
L3 Module: l3basics 2015/11/22 v6315 L3 Basic definitions
L3 Module: l3expan 2015/09/10 v5983 L3 Argument expansion
L3 Module: l3tl 2016/03/26 v6465 L3 Token lists
L3 Module: l3str 2016/03/24 v6441 L3 Strings
L3 Module: l3seq 2015/08/05 v5777 L3 Sequences and stacks
L3 Module: l3int 2016/03/24 v6441 L3 Integers
\c_max_int=\count141
\l_tmpa_int=\count142
\l_tmpb_int=\count143
```

```
\g_tmpa_int=\count144
\g_tmpb_int=\count145
L3 Module: l3quark 2015/08/17 v5855 L3 Quarks
L3 Module: l3prg 2015/11/01 v6216 L3 Control structures
\g__prg_map_int=\count146
L3 Module: l3clist 2015/09/02 v5901 L3 Comma separated lists
L3 Module: l3token 2016/03/26 v6465 L3 Experimental token manipulation
L3 Module: l3prop 2016/01/05 v6366 L3 Property lists
L3 Module: l3msg 2016/03/26 v6464 L3 Messages
L3 Module: l3file 2016/03/25 v6458 L3 File and I/O operations
\l_iow_line_count_int=\count147
\l__iow_target_count_int=\count148
\l__iow_current_line_int=\count149
\l__iow_current_word_int=\count150
\l__iow_current_indentation_int=\count151
L3 Module: l3skip 2016/01/05 v6366 L3 Dimensions and skips
\c_zero_dim=\dimen157
\c_max_dim=\dimen158
\l_tmpa_dim=\dimen159
\l_tmpb_dim=\dimen160
\g_tmpa_dim=\dimen161
\g_tmpb_dim=\dimen162
\c_zero_skip=\skip62
\c_max_skip=\skip63
\l_tmpa_skip=\skip64
\l_tmpb_skip=\skip65
\g_tmpa_skip=\skip66
\g_tmpb_skip=\skip67
\c_zero_muskip=\muskip12
\c_max_muskip=\muskip13
\l_tmpa_muskip=\muskip14
\l_tmpb_muskip=\muskip15
\g_tmpa_muskip=\muskip16
\g_tmpb_muskip=\muskip17
L3 Module: l3keys 2015/11/17 v6284 L3 Key-value interfaces
\g__keyval_level_int=\count152
\l_keys_choice_int=\count153
L3 Module: l3fp 2016/03/26 v6465 L3 Floating points
\c__fp_leading_shift_int=\count154
\c__fp_middle_shift_int=\count155
\c__fp_trailing_shift_int=\count156
\c__fp_big_leading_shift_int=\count157
\c__fp_big_middle_shift_int=\count158
\c__fp_big_trailing_shift_int=\count159
\c__fp_Bigg_leading_shift_int=\count160
\c__fp_Bigg_middle_shift_int=\count161
\c__fp_Bigg_trailing_shift_int=\count162
L3 Module: l3box 2015/08/09 v5822 L3 Experimental boxes
\c_empty_box=\box39
\l_tmpa_box=\box40
\l_tmpb_box=\box41
\g_tmpa_box=\box42
\g_tmpb_box=\box43
L3 Module: l3coffins 2016/03/24 v6440 L3 Coffin code layer
```

```
\l__coffin_internal_box=\box44
\l__coffin_internal_dim=\dimen163
\l__coffin_offset_x_dim=\dimen164
\l__coffin_offset_y_dim=\dimen165
\l__coffin_x_dim=\dimen166
\l__coffin_y_dim=\dimen167
\l__coffin_x_prime_dim=\dimen168
\l__coffin_y_prime_dim=\dimen169
\c_empty_coffin=\box45
\l__coffin_aligned_coffin=\box46
\l__coffin_aligned_internal_coffin=\box47
\l_tmpa_coffin=\box48
\l_tmpb_coffin=\box49
\l__coffin_display_coffin=\box50
\l__coffin_display_coord_coffin=\box51
\l__coffin_display_pole_coffin=\box52
\l__coffin_display_offset_dim=\dimen170
\l__coffin_display_x_dim=\dimen171
\l__coffin_display_y_dim=\dimen172
L3 Module: l3color 2014/08/23 v5354 L3 Experimental color support
L3 Module: l3sys 2015/09/25 v6087 L3 Experimental system/runtime
functions
L3 Module: l3candidates 2016/03/25 v6456 L3 Experimental additions to
l3kernel
\l__box_top_dim=\dimen173
\l__box_bottom_dim=\dimen174
\l__box_left_dim=\dimen175
\l__box_right_dim=\dimen176
\l__box_top_new_dim=\dimen177
\l__box_bottom_new_dim=\dimen178
\l__box_left_new_dim=\dimen179
\l__box_right_new_dim=\dimen180
\l__box_internal_box=\box53
\l__coffin_bounding_shift_dim=\dimen181
\l__coffin_left_corner_dim=\dimen182
\l__coffin_right_corner_dim=\dimen183
\l__coffin_bottom_corner_dim=\dimen184
\l__coffin_top_corner_dim=\dimen185
\l__coffin_scaled_total_height_dim=\dimen186
\l__coffin_scaled_width_dim=\dimen187
L3 Module: l3luatex 2016/03/26 v6465 L3 Experimental LuaTeX-specific
functions
) (c:/TeXLive/2015/texmf-dist/tex/latex/l3kernel/l3pdfmode.def
File: l3pdfmode.def 2016/03/26 v6465 L3 Experimental driver: PDF mode
\l__driver_color_stack_int=\count163
))
Package: breqn 2015/08/11 v0.98d Breaking equations
(c:/TeXLive/2015/texmf-dist/tex/latex/breqn/flexisym.sty
Package: flexisym 2015/08/11 v0.98d Make math characters macros
LaTeX Info: Redefining \textprime on input line 299.
LaTeX Info: Redefining \not on input line 357.
(c:/TeXLive/2015/texmf-dist/tex/latex/breqn/cmbase.sym
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 \neq 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 \longleftrightarrow on input line 352.
LaTeX Info: Redefining \Longleftrightarrow 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
.
) (./gopinathargallauro2017_2.aux)
\openout1 = `gopinathargallauro2017_2.aux'.
```

```
LaTeX Font Info:    Checking defaults for OML/cmm/m/it on input line 51.
LaTeX Font Info:    ... okay on input line 51.
LaTeX Font Info:    Checking defaults for T1/cmr/m/n on input line 51.
LaTeX Font Info:    ... okay on input line 51.
LaTeX Font Info:    Checking defaults for OT1/cmr/m/n on input line 51.
LaTeX Font Info:    ... okay on input line 51.
LaTeX Font Info:    Checking defaults for OMS/cmsy/m/n on input line 51.
LaTeX Font Info:    ... okay on input line 51.
LaTeX Font Info:    Checking defaults for OMX/cmex/m/n on input line 51.
LaTeX Font Info:    ... okay on input line 51.
LaTeX Font Info:    Checking defaults for U/cmr/m/n on input line 51.
LaTeX Font Info:    ... okay on input line 51.
LaTeX Font Info:    Checking defaults for TS1/cmr/m/n on input line 51.
LaTeX Font Info:    ... okay on input line 51.
(c:/TeXLive/2015/texmf-dist/tex/context/base/supp-pdf.mkii
[Loading MPS to PDF converter (version 2006.09.02).]
\scratchcounter=\count180
\scratchdimen=\dimen268
\scratchbox=\box60
\nofMPsegments=\count181
\nofMParguments=\count182
\everyMPshowfont=\toks35
\MPscratchCnt=\count183
\MPscratchDim=\dimen269
\MPnumerator=\count184
\makeMPintoPDFobject=\count185
\everyMPtoPDFconversion=\toks36
) (c:/TeXLive/2015/texmf-dist/tex/generic/oberdiek/pdftexcmds.sty
Package: pdftexcmds 2011/11/29 v0.20 Utility functions of pdfTeX for
LuaTeX (HO
)
(c:/TeXLive/2015/texmf-dist/tex/generic/oberdiek/ifluatex.sty
Package: ifluatex 2010/03/01 v1.3 Provides the ifluatex switch (HO)
Package ifluatex Info: LuaTeX not detected.
) (c:/TeXLive/2015/texmf-dist/tex/generic/oberdiek/ifpdf.sty
Package: ifpdf 2011/01/30 v2.3 Provides the ifpdf switch (HO)
Package ifpdf Info: pdfTeX in PDF mode is detected.
)
Package pdftexcmds Info: LuaTeX not detected.
Package pdftexcmds Info: \pdf@primitive is available.
Package pdftexcmds Info: \pdf@ifprimitive is available.
Package pdftexcmds Info: \pdfdraftmode found.
) (c:/TeXLive/2015/texmf-dist/tex/latex/oberdiek/epstopdf-base.sty
Package: epstopdf-base 2010/02/09 v2.5 Base part for package epstopdf
(c:/TeXLive/2015/texmf-dist/tex/latex/oberdiek/grfext.sty
Package: grfext 2010/08/19 v1.1 Manage graphics extensions (HO)
(c:/TeXLive/2015/texmf-dist/tex/generic/oberdiek/kvdefinekeys.sty
Package: kvdefinekeys 2011/04/07 v1.3 Define keys (HO)
)) (c:/TeXLive/2015/texmf-dist/tex/latex/oberdiek/kvoptions.sty
Package: kvoptions 2011/06/30 v3.11 Key value format for package options
(HO)
(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 51.
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
85.
(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
85.
(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
85.
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
85.
LaTeX Font Info:    Calculating math sizes for size <8.5> on input line
85.
Package epstopdf Info: Source file: <Fig1.eps>
(epstopdf)                    date: 2017-12-01 23:24:13
(epstopdf)                    size: 3011293 bytes
(epstopdf)             Output file: <Fig1-eps-converted-to.pdf>
(epstopdf)                    date: 2017-12-01 23:24:39
(epstopdf)                    size: 1698620 bytes
(epstopdf)             Command: <repstopdf --outfile=Fig1-eps-converted-
to.pdf
Fig1.eps>
(epstopdf)             \includegraphics on input line 100.
Package epstopdf Info: Output file is already uptodate.
<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
100.
(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
101.
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
101.
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
101.
[1{c:/TeXLive/2015/texmf-var/fonts/map/pdftex/updmap/pdftex.map}


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

Package epstopdf Info: Source file: <Fig2.eps>
(epstopdf)                    date: 2017-12-01 23:24:13
(epstopdf)                    size: 125295 bytes
(epstopdf)             Output file: <Fig2-eps-converted-to.pdf>
(epstopdf)                    date: 2017-12-01 23:24:46
(epstopdf)                    size: 126768 bytes
(epstopdf)             Command: <repstopdf --outfile=Fig2-eps-converted-
to.pdf
Fig2.eps>
(epstopdf)             \includegraphics on input line 118.
Package epstopdf Info: Output file is already uptodate.
<Fig2-eps-converted-to.pdf, id=16, 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
118.
(pdftex.def)           Requested size: 173.25302pt x 125.02275pt.
```

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


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

[3 <./Fig1-eps-converted-to.pdf> <./Fig2-eps-converted-to.pdf>]
Underfull \vbox (badness 10000) has occurred while \output is active []

[4]
Package epstopdf Info: Source file: <Fig3.eps>
(epstopdf)                          date: 2017-12-01 23:24:13
(epstopdf)                          size: 49232 bytes
(epstopdf)                   Output file: <Fig3-eps-converted-to.pdf>
(epstopdf)                          date: 2017-12-01 23:24:50
(epstopdf)                          size: 39004 bytes
(epstopdf)                       Command: <repstopdf --outfile=Fig3-eps-converted-
to.pdf
Fig3.eps>
(epstopdf)                       \includegraphics on input line 166.
Package epstopdf Info: Output file is already uptodate.
<Fig3-eps-converted-to.pdf, id=39, 478.78876pt x 438.63875pt>
File: Fig3-eps-converted-to.pdf Graphic file (type pdf)
<use Fig3-eps-converted-to.pdf>
Package pdftex.def Info: Fig3-eps-converted-to.pdf used on input line
166.
(pdftex.def)              Requested size: 238.96417pt x 218.92393pt.
[5 <./Fig3-eps-converted-to.pdf>]
Package epstopdf Info: Source file: <Fig4.eps>
(epstopdf)                          date: 2017-12-01 23:24:13
(epstopdf)                          size: 411428 bytes
(epstopdf)                   Output file: <Fig4-eps-converted-to.pdf>
(epstopdf)                          date: 2017-12-01 23:24:56
(epstopdf)                          size: 798504 bytes
(epstopdf)                       Command: <repstopdf --outfile=Fig4-eps-converted-
to.pdf
Fig4.eps>
(epstopdf)                       \includegraphics on input line 222.
Package epstopdf Info: Output file is already uptodate.
<Fig4-eps-converted-to.pdf, id=55, 1314.9125pt x 736.7525pt>
File: Fig4-eps-converted-to.pdf Graphic file (type pdf)
<use Fig4-eps-converted-to.pdf>
Package pdftex.def Info: Fig4-eps-converted-to.pdf used on input line
222.
(pdftex.def)              Requested size: 569.25363pt x 299.59726pt.
[6] [7 <./Fig4-eps-converted-to.pdf>]
LaTeX Font Info:    Try loading font information for U+bbm on input line
291.
(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]

LaTeX Font Warning: Font shape `U/bbm/m/n' in size <8.5> not available
(Font)              size <8> substituted on input line 328.
```

```
LaTeX Font Warning: Font shape `U/bbm/m/n' in size <4.25> not available
(Font)              size <5> substituted on input line 328.

Package epstopdf Info: Source file: <Fig5.eps>
(epstopdf)                          date: 2017-12-01 23:24:14
(epstopdf)                          size: 310438 bytes
(epstopdf)              Output file: <Fig5-eps-converted-to.pdf>
(epstopdf)                          date: 2017-12-01 23:25:02
(epstopdf)                          size: 83442 bytes
(epstopdf)              Command: <repstopdf --outfile=Fig5-eps-converted-
to.pdf
Fig5.eps>
(epstopdf)              \includegraphics on input line 345.
Package epstopdf Info: Output file is already uptodate.
<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>
Package pdftex.def Info: Fig5-eps-converted-to.pdf used on input line
345.
(pdftex.def)            Requested size: 238.9604pt x 93.20837pt.
Package epstopdf Info: Source file: <Fig6.eps>
(epstopdf)                          date: 2017-12-01 23:24:14
(epstopdf)                          size: 6490402 bytes
(epstopdf)              Output file: <Fig6-eps-converted-to.pdf>
(epstopdf)                          date: 2017-12-01 23:25:08
(epstopdf)                          size: 337764 bytes
(epstopdf)              Command: <repstopdf --outfile=Fig6-eps-converted-
to.pdf
Fig6.eps>
(epstopdf)              \includegraphics on input line 351.
Package epstopdf Info: Output file is already uptodate.
<Fig6-eps-converted-to.pdf, id=75, 1927.2pt x 542.025pt>
File: Fig6-eps-converted-to.pdf Graphic file (type pdf)
<use Fig6-eps-converted-to.pdf>
Package pdftex.def Info: Fig6-eps-converted-to.pdf used on input line
351.
(pdftex.def)            Requested size: 495.0pt x 139.21115pt.
[9 <./Fig5-eps-converted-to.pdf>]
Package epstopdf Info: Source file: <Fig7.eps>
(epstopdf)                          date: 2017-12-01 23:24:14
(epstopdf)                          size: 34226 bytes
(epstopdf)              Output file: <Fig7-eps-converted-to.pdf>
(epstopdf)                          date: 2017-12-01 23:25:13
(epstopdf)                          size: 10330 bytes
(epstopdf)              Command: <repstopdf --outfile=Fig7-eps-converted-
to.pdf
Fig7.eps>
(epstopdf)              \includegraphics on input line 384.
Package epstopdf Info: Output file is already uptodate.
<Fig7-eps-converted-to.pdf, id=82, 682.55pt x 371.3875pt>
File: Fig7-eps-converted-to.pdf Graphic file (type pdf)
<use Fig7-eps-converted-to.pdf>
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```
Package pdftex.def Info: Fig7-eps-converted-to.pdf used on input line
384.
(pdftex.def)              Requested size: 450.45181pt x 245.0995pt.
[10 <./Fig6-eps-converted-to.pdf>]
Overfull \hbox (1.40538pt too wide) in paragraph at lines 394--395
$[]$\OT1/cmr/m/n/10 (-20) : In the sec-ond phase of train-ing, the
blending-
 []


Underfull \vbox (badness 3291) has occurred while \output is active []

Package epstopdf Info: Source file: <Fig8.eps>
(epstopdf)                        date: 2017-12-01 23:24:14
(epstopdf)                        size: 193852 bytes
(epstopdf)                 Output file: <Fig8-eps-converted-to.pdf>
(epstopdf)                        date: 2017-12-01 23:25:18
(epstopdf)                        size: 215176 bytes
(epstopdf)              Command: <repstopdf --outfile=Fig8-eps-converted-
to.pdf
Fig8.eps>
(epstopdf)              \includegraphics on input line 417.
Package epstopdf Info: Output file is already uptodate.
<Fig8-eps-converted-to.pdf, id=92, 716.6775pt x 541.02126pt>
File: Fig8-eps-converted-to.pdf Graphic file (type pdf)
<use Fig8-eps-converted-to.pdf>
Package pdftex.def Info: Fig8-eps-converted-to.pdf used on input line
417.
(pdftex.def)              Requested size: 415.79819pt x 313.8916pt.
[11 <./Fig7-eps-converted-to.pdf>]
Underfull \vbox (badness 1824) has occurred while \output is active []

Package epstopdf Info: Source file: <Fig9.eps>
(epstopdf)                        date: 2017-12-01 23:24:14
(epstopdf)                        size: 2099967 bytes
(epstopdf)                 Output file: <Fig9-eps-converted-to.pdf>
(epstopdf)                        date: 2017-12-01 23:25:24
(epstopdf)                        size: 157574 bytes
(epstopdf)              Command: <repstopdf --outfile=Fig9-eps-converted-
to.pdf
Fig9.eps>
(epstopdf)              \includegraphics on input line 450.
Package epstopdf Info: Output file is already uptodate.
<Fig9-eps-converted-to.pdf, id=104, 619.31375pt x 257.96375pt>
File: Fig9-eps-converted-to.pdf Graphic file (type pdf)
<use Fig9-eps-converted-to.pdf>
Package pdftex.def Info: Fig9-eps-converted-to.pdf used on input line
450.
(pdftex.def)              Requested size: 396.00151pt x 164.95451pt.
[12 <./Fig8-eps-converted-to.pdf>]
Package epstopdf Info: Source file: <Fig10.eps>
(epstopdf)                        date: 2017-12-01 23:24:14
(epstopdf)                        size: 28366 bytes
(epstopdf)                 Output file: <Fig10-eps-converted-to.pdf>
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(epstopdf)                          date: 2017-12-01 23:25:28
(epstopdf)                          size: 8842 bytes
(epstopdf)              Command: <repstopdf --outfile=Fig10-eps-converted-
to.pdf
 Fig10.eps>
(epstopdf)                  \includegraphics on input line 462.
Package epstopdf Info: Output file is already uptodate.
<Fig10-eps-converted-to.pdf, id=114, 619.31375pt x 447.6725pt>
File: Fig10-eps-converted-to.pdf Graphic file (type pdf)
<use Fig10-eps-converted-to.pdf>
Package pdftex.def Info: Fig10-eps-converted-to.pdf used on input line
462.
(pdftex.def)               Requested size: 238.96417pt x 172.73355pt.

LaTeX Warning: `!h' float specifier changed to `!ht'.


[13]
Underfull \hbox (badness 1496) in paragraph at lines 560--562
\OT1/cmr/m/n/8.5 (+20) inhibition type neu-ral fields. \OT1/cmr/m/it/8.5
(+20)
Bi-o-log-i-cal Cy-ber-net-ics
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Package balance Warning: You have called \balance in second column
(balance)                  Columns might not be balanced.

[14 <./Fig9-eps-converted-to.pdf> <./Fig10-eps-converted-to.pdf>]
Underfull \vbox (badness 10000) has occurred while \output is active []


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


Overfull \vbox (0.82639pt too high) has occurred while \output is active
[]


Overfull \vbox (3.37914pt too high) has occurred while \output is active
[]

[15]
Overfull \hbox (0.87498pt too wide) in paragraph at lines 804--807
\OT1/cmr/m/it/8.5 (-20) IEEE Transactions on Biomedical Engineering
\OT1/cmr/m/
n/8.5 (-20) 55(8):2050--
 []

Missing character: There is no â in font cmr8!
Missing character: There is no € in font cmr8!
Missing character: There is no œ in font cmr8!
Missing character: There is no â in font cmr8!
Missing character: There is no € in font cmr8!
Missing character: There is no • in font cmr8!
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[16] (./gopinathargallauro2017_2.aux)

LaTeX Font Warning: Size substitutions with differences
(Font)   up to 0.75pt have occurred.

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 15152 strings out of 493027
 259017 string characters out of 6137679
 458130 words of memory out of 5000000
 18210 multiletter control sequences out of 15000+600000
 27775 words of font info for 203 fonts, out of 8000000 for 9000
 1141 hyphenation exceptions out of 8191
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  38i,20n,51p,10406b,592s 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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bm10.pfb>
Output written on gopinathargallauro2017_2.pdf (16 pages, 3797964 bytes).
PDF statistics:
 212 PDF objects out of 1000 (max. 8388607)
 135 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 hosptial in the United States. She is the director of the **a**ssistive & **r**ehabilitation robotics **lab**oratory (**ar**gal**lab**). Her research lies in the intersection of robotics, machine learning and human rehabilitation. The mission of the **ar**gal**lab** 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).

BA