# `ost`stud — OST-Stud Style and Macros*

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Released 2022/11/22

## Contents

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*This document corresponds to `oststud` v0.2, last revised 2022/11/22.

# 1  Purpose of this Package

This package is made for the OST Studenten organization to provide an easy to use interface that gives a more consistent look and feel to the works produced by its members. This package is the successor after the fusion of the old `hsrstud` package.

# 2  Package Options

**dontrenew** Do not renew existing LaTeX commands and environments. This is useful when the package is loaded on a document that is already partially written.

**textvecdiff** Disables the "Nabla" or "Del" notation for vector derivatives. Instead the symbols $\nabla, \nabla\cdot, \nabla\times, \nabla^2, \nabla^2$ are be replaced with grad, div, curl and div grad.

**textvecdiff** *Work in progress.*

**bfemph** *Work in progress.*

**bbprobability** *Work in progress.*

**scrtransforms** *Work in progress.*

# 3  Usage

## 3.1  Vectors and Vector Calculus

`\vec` In the physics used by electrical engineers it is common to use lowercase bold
`\uvec` letters for vectors (with the exception of electromagnetic fields $\mathbf{E}, \mathbf{B}, \mathbf{A}, \ldots$). If the `dontrenew` option is set a new macro `\bvec` (bold `\vec`) that takes a {⟨*symbol*⟩} defines the bold vector notation. Otherwise the default vector notation with the tiny ugly arrow ($\vec{u}$) is replaced by bold and the arrow notation saved in `\oldvec`. In vector calculus it is common to denote unit vectors by putting a hat, so there is a macro `\uvec` that does just that:

$$\hat{\mathbf{u}} = \mathbf{u}/u.$$

`\dotp`     To differentiate the dot and cross products (between vectors) from normal
`\crossp` product between scalars ($a \cdot b$ and $a \times b$), the macros `\dotp` and `\crossp` provide a bold variant:
$$\mathbf{u}\cdot\mathbf{v}, \qquad \mathbf{u}\times\mathbf{v}.$$

`\grad`     The macros `\grad`, `\div` and `\curl` provide symbols for the gradient, diver-
`\div` gence and curl operators used in vector calculus. If the option `textvecdiff` is
`\curl` set, they symbols are written as words, otherwise they will he written (ab)using the Nabla symbol, i.e. by pretending that the symbol $\nabla$ is a "vector" (sometime referred to as "del") of partial derivates: $\nabla = (\partial_x, \partial_y, \partial_z)^{\mathsf{T}}$. Unless the option `dontrenew` is set, the division symbol is replaced by the divergence and the symbol $\div$ is saved in `\divsymb`. For a scalar field $\phi$ or a vector field $\mathbf{F}$ the notation (in order) of the gradient, divergence and curl appear as follows:

$$\nabla\,\phi, \quad \nabla\cdot\mathbf{F}, \quad \nabla\times\mathbf{F}.$$

`\laplacian` Continuing with the (ab)use of the "Nabla" or "Del" notation, the there is a
`\vlaplacian` macro `\laplacian` for the Laplacian operator

$$\nabla^2 \equiv \boldsymbol{\nabla} \cdot \boldsymbol{\nabla} \equiv \sum_i \partial_i^2.$$

Notice that the Nabla symbol is not bold, that is because the Laplacian operator results in a scalar value. Though, sometimes in electrodynamics the vector Laplacian is used (which applies the Laplacian operator to each component). To differentiate the two there is a macro `\vlaplacian` which uses the bold nabla symbol: $\boldsymbol{\nabla}^2$. If the option `dontrenew` is set both symbols are replaced by div grad.

## 3.2 Linear Algebra

`\mx` Similarly to vectors it is common to write matrices as uppercase bold letters, thus the `\mx` macro takes a `{`⟨*symbol*⟩`}` and typesets it as upright bold.

`\mt` The "normal" and Hermitian (complex conjugate) transpose of a matrix $\mathbf{F}$ are
`\mh` denoted by a superscript sans-serif T or H respectively ($\mathbf{F}^\mathsf{T}$ resp. $\mathbf{F}^\mathsf{H}$). The `\mt` and `\mh` macros (matrix transpose and Hermitian transpose) provide this notation; They both take a `{`⟨*symbol*⟩`}`. In abstract vector spaces the Hermitian transpose becomes the adjoint, for which it is common to use a superscript dagger (adjoint of $\mathcal{Q}$ is $\mathcal{Q}^\dagger$), but since it does not come up very often this package does *not* provide a macro for the adjoint.

`\minv` Another common matrix operation that is annoying to write is the matrix inverse, which is usually written as a superscript -1. The `\minv` command takes a `{`⟨*matrix*⟩`}` and adds the -1 superscript.

Using all of the above we can typeset the matrix form of the linear least squares approximation by writing

> `\vec{a} = \minv{(\mt{\mx{Q}} \mx{Q})} \mt{\mx{Q}}\vec{y}`

which results in the following:

$$\mathbf{a} = (\mathbf{Q}^\mathsf{T}\mathbf{Q})^{-1}\mathbf{Q}^\mathsf{T}\mathbf{y} \iff \arg\min_{(a_1,a_2)} \left( \sum_{i=0}^n y_i - a_1 x_i + a_2 \right).$$

`\tr` This package also provides a macro for the trace of a matrix.

## 3.3 Complex Numbers

`\Re` AMS maths's default notation for the real and imaginary parts of a complex
`\Im` number use the Fraktur font capital letters $\Re$ and $\Im$. However, in engineering it is more common to see the notation $\operatorname{Re}\{z\}$ and $\operatorname{Im}\{z\}$, thus, unless the `dontrenew` option is set this package replaces the notation with the former symbols. Both of the macros were also modified to take an argument `{`⟨*expression*⟩`}`, to surround the expression with opening and closing curly brackets.

## 3.4 Probability Operators

*Work in progress.*

## 3.5 Transformation Operators

*Work in progress.*

$$\mathcal{L}\{f(t)\} = F(s) \circ\!\!\!-\!\!\bullet f(t) \bullet\!\!-\!\!\!\circ F(s)$$

## 3.6 References

*Work in progress.*

## 3.7 OST Colors

The official OST color palette provides the following "primary" or "accent" colors.

| | | | |
|---|---|---|---|
| OSTBlack | OSTGray | OSTBlackberry | OSTRaspberry |

And then there are the other "design colors".

| | | |
|---|---|---|
| OSTDarkOrange | OSTOrange | OSTLightOrange |
| OSTDarkRed | OSTRed | OSTLightRed |
| OSTDarkPurple | OSTPurple | OSTLightPurple |
| OSTDarkBlue | OSTBlue | OSTLightBlue |
| OSTDarkGreen | OSTGreen | OSTLightGreen |

## 3.8 Sane Defaults

*Work in progress.*

# 4 Implementation

## 4.1 Dependencies and Parse Options

First, we have the dependencies necessary for typesetting.

```
1 \RequirePackage{xcolor}
2 \RequirePackage{amsmath}
3 \RequirePackage{amssymb}
4 \RequirePackage{bm}
```

This package also sets sane defaults to the following packages.

```
5 \RequirePackage{hyperref}
6 \RequirePackage{listings}
```

Then we create the options for the package.

```
 7 \SetupKeyvalOptions{
 8     family=ost,
 9     prefix=ost@
10 }
11 \DeclareBoolOption[false]{dontrenew}
12 \DeclareBoolOption[false]{textvecdiff}
13 \DeclareBoolOption[false]{bfemph}
14 \DeclareBoolOption[false]{bbprobability}
15 % \DeclareBoolOption[false]{scrtransforms}
16 \ProcessLocalKeyvalOptions*
```

## 4.2   Bold emphasis

\emph Change the behaviour of \emph.

```
17 \ifost@bfemph
18     \ifost@dontrenew
19         \PackageError{The options \noexpand\dontrenew and \noexpand\bfemph cannot be used at
20     \fi
21     \long\expandafter\def\csname em \endcsname{%
22         \@nomath\em
23         \if b\expandafter\@car\f@series\@nil
24             \itshape\else\bfseries\fi
25     }
26 \fi
```

## 4.3   Vectors and Vector Calculus

\vec Set up bold notation for vectors.

```
27 \newcommand{\ost@vec}[1]{\mathbf{\bm{#1}}}
28 \ifost@dontrenew
29     \newcommand{\bvec}[1]{\ost@vec{#1}}
30 \else
31     \let\oldvec\vec
32     \renewcommand{\vec}[1]{\ost@vec{#1}}
33 \fi
```

\uvec In vector calculus unit vectors are usually denoted by a hat.

```
34 \newcommand{\uvec}[1]{\vec{\hat{#1}}}
```

\dotp To differentiate them from \cdot and \times which are for scalars.

\crossp
```
35 \DeclareMathOperator{\dotp}{\boldsymbol\cdot}
36 \DeclareMathOperator{\crossp}{\boldsymbol\times}
```

\grad Gradient of a vector valued scalar functon.

```
37 \ifost@textvecdiff
38     \DeclareMathOperator{\grad}{grad}
39 \else
40     \DeclareMathOperator{\grad}{\vec{\nabla}}
41 \fi
```

5

\div  Divergence operator. If the option `dontrenew` is a new macro `\divg` is defined. Otherwise `\div` is renamed to `\divsymb`.

```
42 \ifost@textvecdiff
43     \DeclareMathOperator{\ost@div}{div}
44 \else
45     \DeclareMathOperator{\ost@div}{\vec{\nabla}\dotp}
46 \fi
47 \ifost@dontrenew
48     \DeclareMathOperator{\divg}{\ost@div}
49 \else
50     \let\divsymb\div
51     \renewcommand{\div}{\ost@div}
52 \fi
```

\curl  Curl of a vector field.

```
53 \ifost@textvecdiff
54     \DeclareMathOperator{\curl}{curl}
55 \else
56     \DeclareMathOperator{\curl}{\vec{\nabla}\crossp}
57 \fi
```

\laplacian  Laplacian of a scalar and vector field.
\vlaplacian
```
58 \ifost@textvecdiff
59     \DeclareMathOperator{\laplacian}{\div\grad}
60     \DeclareMathOperator{\vlaplacian}{\div\grad}
61 \else
62     \DeclareMathOperator{\laplacian}{\nabla^2}
63     \DeclareMathOperator{\vlaplacian}{\vec{\nabla}^2}
64 \fi
```

## 4.4  Linear Algebra

\mx  Notation for matrices as bold (uppercase) letters.

```
65 \newcommand{\mx}[1]{\mathbf{\bm{#1}}}
```

\mt  Normal and Hermitian (conjugate) transpose of a matrix.
\mh
```
66 \newcommand{\mt}[1]{{#1}^\mathsf{T}}
67 \newcommand{\mh}[1]{{#1}^\mathsf{H}}
```

\minv  Matrix inverse.

```
68 \newcommand{\minv}[1]{{#1}^{-1}}
```

\tr  Trace of a matrix.

```
69 \DeclareMathOperator{\tr}{tr}
```

## 4.5  Mathematical Programming

\argmin
\argmax
```
70 \DeclareMathOperator*{\argmax}{arg\,max}
71 \DeclareMathOperator*{\argmin}{arg\,min}
```

## 4.6 Complex Numbers

\Re \Im  Replace the real and imaginary operators to look "normal", that is not using the Fraktur fonts.

```
72 \ifost@dontrenew\else
73     \let\oldRe\Re \let\oldIm\Im
74     \renewcommand{\Re}[1]{\mathrm{Re} \left\{#1\right\}}
75     \renewcommand{\Im}[1]{\mathrm{Im} \left\{#1\right\}}
76 \fi
```

## 4.7 Probability Operators

\E  Expectation of a random variable.

```
77 \ifost@bbprobability
78     \DeclareMathOperator{\ost@expectation}{\mathbb{E}}
79 \else
80     \DeclareMathOperator{\ost@expectation}{E}
81 \fi
82 \newcommand{\E}[1]{\ost@expectation\left\{#1\right\}}
```

\Var  Variance of a random variable.

```
83 \ifost@bbprobability
84     \DeclareMathOperator{\ost@variance}{\mathbb{V}}
85 \else
86     \DeclareMathOperator{\ost@variance}{Var}
87 \fi
88 \newcommand{\Var}[1]{\ost@variance\left\{#1\right\}}
```

\Pr  Probability operator.

```
89 \ifost@bbprobability
90     \DeclareMathOperator{\ost@probability}{\mathbb{P}}
91 \else
92     \DeclareMathOperator{\ost@probability}{Pr}
93 \fi
94 \ifost@dontrenew
95     \newcommand{\P}[1]{\ost@probability\left\{#1\right\}}
96 \else
97     \renewcommand{\Pr}[1]{\ost@probability\left\{#1\right\}}
98 \fi
```

## 4.8 Transformation Operators

\fourier \ifourier  Fourier transform and its inverse.

```
 99 \DeclareMathOperator{\fourier}{\mathcal{F}}
100 \DeclareMathOperator{\ifourier}{\mathcal{F}^{-1}}
```

\laplace \ilaplace  Laplace transform and its inverse.

```
101 \DeclareMathOperator{\laplace}{\mathcal{L}}
102 \DeclareMathOperator{\ilaplace}{\mathcal{L}^{-1}}
```

\ztransf \iztransf  Z-transform and its inverse.

```
103 \DeclareMathOperator{\ztransf}{\mathcal{Z}}
104 \DeclareMathOperator{\iztransf}{\mathcal{Z}^{-1}}
```

<dl>
<dt>\hilbert</dt>
<dd>Hilbert transform.</dd>
</dl>

```
105 \DeclareMathOperator{\hilbert}{\mathcal{H}}
```

<dl>
<dt>\corresponds<br>\rcorresponds</dt>
<dd>Correspondence symbols.</dd>
</dl>

```
106 \newcommand{\corresponds}{%
107     \mbox{\setlength{\unitlength}{0.1em}%
108         \begin{picture}(20,10)%
109             \put(5,3){\circle{4}}%
110             \put(7,3){\line(1,0){7}}%
111             \put(16,3){\circle*{4}}%
112         \end{picture}}}
113 \newcommand{\rcorresponds}{%
114     \mbox{\setlength{\unitlength}{0.1em}%
115         \begin{picture}(20,10)%
116             \put(5,3){\circle*{4}}%
117             \put(7,3){\line(1,0){7}}%
118             \put(16,3){\circle{4}}%
119         \end{picture}}}
```

## 4.9 References

<dl>
<dt>\skriptum<br>\sref</dt>
<dd>Reference material in the skriptum (lecture notes) of the course.</dd>
</dl>

```
120 \newcommand{\ost@skriptum}{\PackageWarning{No \noexpand\skriptum given}}
121 \newcommand{\skriptum}[1]{\gdef\ost@skriptum{#1}}
122 \newcommand{\sref}[1]{%
123     \texttt{\textcolor{OSTBlackberry}{#1}}\nocite{\ost@skriptum}}
```

<dl>
<dt>\textbook<br>\bref</dt>
<dd>Reference material in the textbook of the course.</dd>
</dl>

```
124 \newcommand{\ost@textbook}{\PackageWarning{No \noexpand\textbook given}}
125 \newcommand{\textbook}[1]{\gdef\ost@textbook{#1}}
126 \newcommand{\bref}[1]{%
127     \texttt{\textcolor{OSTRaspberry}{#1}}\nocite{\ost@textbook}}
```

## 4.10 OST Colors

Define the colors according to the OST corporate design. The code was kindly stolen from H. Badertscher's `OSTColors.sty` [?]. First there are the "primary colors".

```
128 \definecolor{OSTBlack}{RGB}{25,25,25}
129 \definecolor{OSTGray}{RGB}{198,198,198}
130 \definecolor{OSTBlackberry}{RGB}{140,25,95}
131 \definecolor{OSTRaspberry}{RGB}{215,40,100}
```

Then the "design colors".

```
132 \definecolor{OSTPurple}{RGB}{149,96,164}
133 \definecolor{OSTDarkPurple}{RGB}{107,56,129}
134 \definecolor{OSTLightPurple}{RGB}{208,169,208}

135 \definecolor{OSTGreen}{RGB}{29,175,142}
136 \definecolor{OSTDarkGreen}{RGB}{0,126,107}
137 \definecolor{OSTLightGreen}{RGB}{167,213,194}

138 \definecolor{OSTRed}{RGB}{232,78,15}
139 \definecolor{OSTDarkRed}{RGB}{195,46,21}
140 \definecolor{OSTLightRed}{RGB}{243,154,139}
```

```
141 \definecolor{OSTBlue}{RGB}{0,134,205}
142 \definecolor{OSTDarkBlue}{RGB}{0,115,176}
143 \definecolor{OSTLightBlue}{RGB}{95,191,237}

144 \definecolor{OSTOrange}{RGB}{251,186,0}
145 \definecolor{OSTDarkOrange}{RGB}{209,143,0}
146 \definecolor{OSTLightOrange}{RGB}{253,214,175}
```

## 4.11   Sane Defaults

First, set up `hyperref` to not look hideous.

```
147 \hypersetup{
148     colorlinks=true,
149     linkcolor=OSTBlack,
150     citecolor=OSTBlackberry,
151     filecolor=OSTBlack,
152     urlcolor=OSTDarkBlue,
153 }
```

Then create a listings style.

```
154 \lstdefinestyle{ost-base}{
155     belowcaptionskip=\baselineskip,
156     breaklines=true,
157     frame=none,
158     inputencoding=utf8,
159     % margin
160     xleftmargin=\parindent,
161     % numbers
162     numbers=left,
163     numbersep=5pt,
164     numberstyle=\ttfamily\footnotesize\color{OSTGray},
165     % background
166     backgroudcolor=\color{white},
167     showstringspaces=false,
168     % default language
169     language=TeX,
170     % break long lines, and show an arrow where the line was broken
171     breaklines=true,
172     postbreak=\mbox{\textcolor{OSTDarkBlue}{$\hookrightarrow$}\space},
173     % font
174     basicstyle=\ttfamily\small,
175     identifierstyle=\color{OSTBlack},
176     keywordstyle=\color{OSTBlue},
177     commentstyle=\color{OSTGray},
178     stringstyle=\color{OSTBlackberry},
179 }
```

Then we set this style to be default.

```
180 \lstset{style=ost-base, escapechar=`}
```

# Change History

v0.1
    General: Initial version . . . . . . . . 1

v0.2
    General: Port features of `hsrstud` . 1

v0.3
    General: Cleanup for CTAN upload   1

# Index

Numbers written in italic refer to the page where the corresponding entry is described; numbers underlined refer to the code line of the definition; numbers in roman refer to the code lines where the entry is used.