

Universität Stuttgart

Inventing Time Travel: Theory and Applications of the Flux Capacitor

Vom Stuttgarter Zentrum für Simulationswissenschaften der
Universität Stuttgart zur Erlangung der Würde eines Doktors der
Naturwissenschaften (Dr. rer. nat.) genehmigte Abhandlung

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Mitberichter: Prof. Dr. Blaise Pascal

Prof. Dr. Marie Curie

Prof. Dr. Charles Darwin

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Institute for Advanced Time Travel

2015

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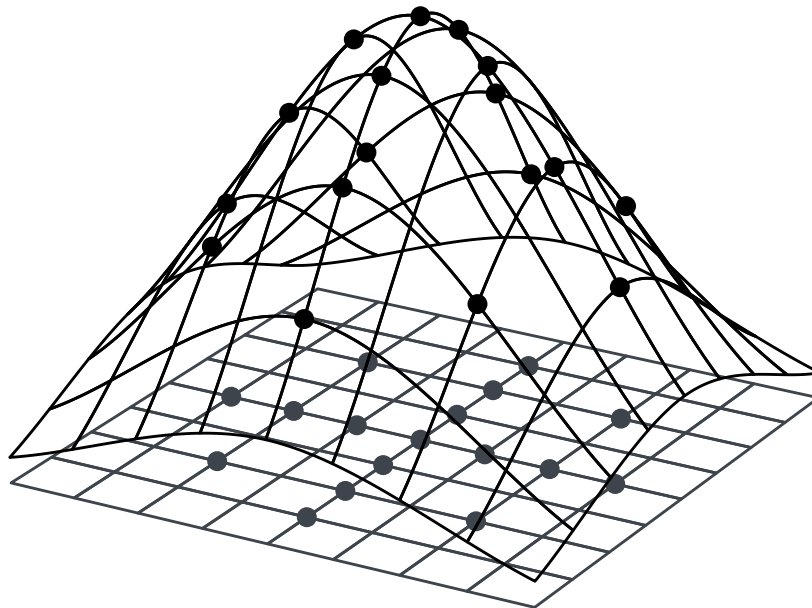
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Emett Brown

INVENTING TIME TRAVEL

Theory and Applications of the
Flux Capacitor



University of Stuttgart
Germany

SimTech

IPVS



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12 “ *It seems that it is not enough to have a good idea*
13 *or insight. One needs, like Schoenberg, the*
14 *appreciation and courage to develop the idea*
15 *systematically, make its objects mathematically*
16 *presentable by giving them names, and give*
17 *them much exposure in many papers.*
18

19 — Carl de Boer [Boo16]
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Symbols and Acronyms		5
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		7
\mathbb{N}	$1, 2, 3, \dots$	8
\mathbb{N}_0	$\mathbb{N} \cup \{0\}$	9
SG^{++}	Sparse grid toolbox for C++	10
WTF	Acronym that you can't spell out on TV	11
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Abstract/Kurzzusammenfassung

Abstract

Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. $\sin^2(\alpha) + \cos^2(\beta) = 1$. If you read this text, you will get no information $E = mc^2$. Really? Is there no information? Is there a difference between this text and some nonsense like „Huardest gefburn“? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. $\sqrt[n]{a} \cdot \sqrt[n]{b} = \sqrt[n]{ab}$. This text should contain all letters of the alphabet and it should be written in of the original language. $\frac{\sqrt[n]{a}}{\sqrt[n]{b}} = \sqrt[n]{\frac{a}{b}}$. There is no need for special contents, but the length of words should match the language. $a\sqrt[n]{b} = \sqrt[n]{a^n b}$.

Kurzzusammenfassung

Dies hier ist ein Blindtext zum Testen von Textausgaben. $d\Omega = \sin\vartheta d\vartheta d\varphi$. Wer diesen Text liest, ist selbst schuld. Der Text gibt lediglich den Grauwert der Schrift an. Ist das wirklich so? Ist es gleichgültig, ob ich schreibe: „Dies ist ein Blindtext“ oder „Huardest gefburn“? Kjift – mitnichten! Ein Blindtext bietet mir wichtige Informationen. $\sin^2(\alpha) + \cos^2(\beta) = 1$. An ihm messe ich die Lesbarkeit einer Schrift, ihre Anmutung, wie harmonisch die Figuren zueinander stehen und prüfe, wie breit oder schmal sie läuft $E = mc^2$. Ein Blindtext sollte möglichst viele verschiedene Buchstaben enthalten und in der Originalsprache gesetzt sein. $\sqrt[n]{a} \cdot \sqrt[n]{b} = \sqrt[n]{ab}$. Er muss keinen Sinn ergeben, sollte aber lesbar sein. $\frac{\sqrt[n]{a}}{\sqrt[n]{b}} = \sqrt[n]{\frac{a}{b}}$. Fremdsprachige Texte wie „Lorem ipsum“ dienen nicht dem eigentlichen Zweck, da sie eine falsche Anmutung vermitteln. $a\sqrt[n]{b} = \sqrt[n]{a^n b}$.

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Preface

Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. $\sin^2(\alpha) + \cos^2(\beta) = 1$. If you read this text, you will get no information $E = mc^2$. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. $\sqrt[n]{a} \cdot \sqrt[n]{b} = \sqrt[n]{ab}$. This text should contain all letters of the alphabet and it should be written in of the original language. $\frac{\sqrt[n]{a}}{\sqrt[n]{b}} = \sqrt[n]{\frac{a}{b}}$. There is no need for special contents, but the length of words should match the language. $a\sqrt[n]{b} = \sqrt[n]{a^n b}$.

Stuttgart, October 21, 2015

Emett Brown

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1 Introduction

“ Ah, Jesus Christ! Jesus Christ, Doc, you disintegrated Einstein!

— Marty McFly

TODO: write

Citations: [Boo72]

Hello World! Hello World!

Now I'm citing all references for demonstration purposes. TODO: don't cite everything

Here are some umlauts: äöüß

I'm testing the glossary: SG⁺⁺ is very cool.

1.1 Bla

This is TODO: write defined TODO: write as $a := 2b$. This is the function f (which is defined as $y =: f(x)$).

Header 1	Header 2	Header 3	Header 4
bla	bla	bla	bla
bla	bla	bla	bla
bla	bla	bla	bla

TABLE 1.1 This is a test table.

$$X \times Y \tag{1.1}$$

$$A \cdot \vec{x} = \vec{b} \tag{1.2}$$

$$\min_{\vec{x} \in [0,1]} \int_{\Omega} f(\vec{x}, \vec{y}) d\vec{y} \tag{1.3}$$

$$4(a+b)f(x)g(x)h(x)p(x)(c+d)fghf'g'h' \tag{1.4}$$

$$f(x)\cos(x)g(x) \tag{1.5}$$

$$\mathrm{f}(x)\cos(x)g(x) \tag{1.6}$$

Table 1.1

Fig. 1.1

Fig. 1.1a

Fig. 1.1b

Fig. 1.2

Algorithm 1.1

THEOREM 1.1 (TODO Theorem)

Hello, here is some text without a meaning. $d\Omega = \sin\vartheta d\vartheta d\varphi$. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. $\sin^2(\alpha) + \cos^2(\beta) = 1$. This text should contain all letters of the alphabet and it should be written in of the original language $E = mc^2$. There

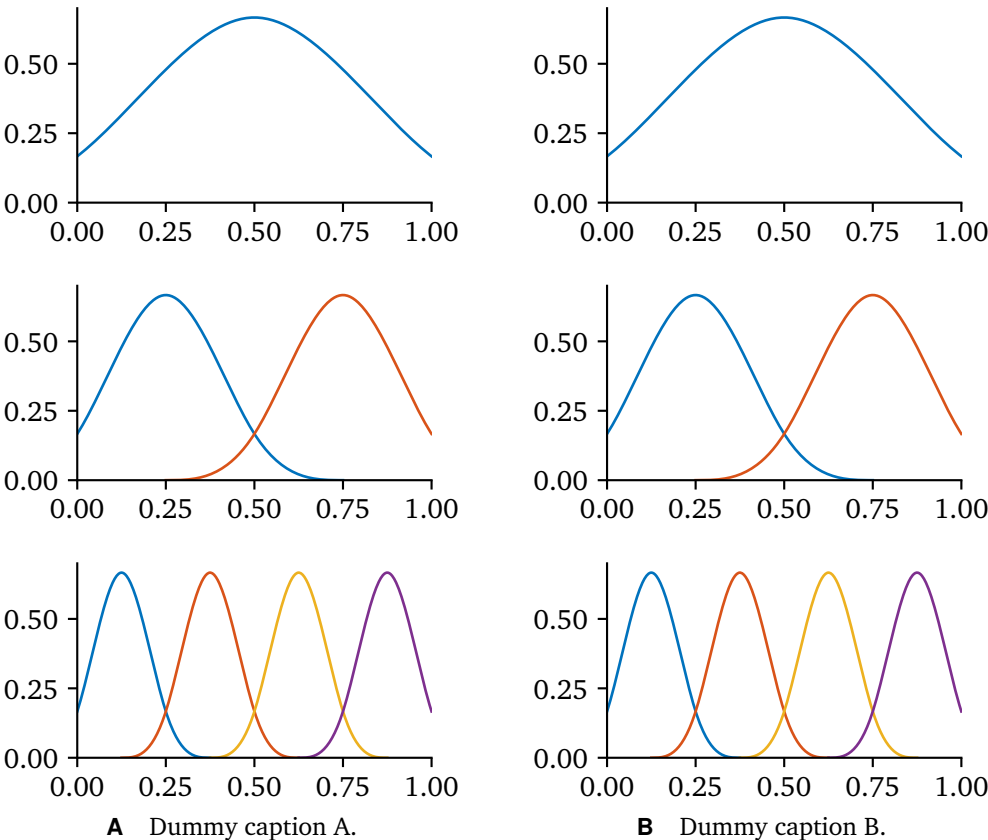


FIGURE 1.1 This is a test caption.

```

1 function  $a = \text{GETAFFECTEDBASISFUNCTIONS}(X, \vec{\alpha}, \vec{x}, t, \vec{\ell}, \vec{j}, b)$ 
2   if  $x_{\vec{\ell}, \vec{j}} \notin X$  then return 0  $\rightsquigarrow$  nichts tun, falls Gitterpunkt nicht vorhanden
3   if  $t = d$  then
4      $a \leftarrow \alpha_{\vec{\ell}, \vec{j}} \cdot (b \cdot \varphi_{\ell_d, j_d}(x_d))$   $\rightsquigarrow$  letzte Dimension: Summanden zu Ergebnis addieren
5     if  $\vec{x}_{\vec{\ell}, \vec{j}}^{(\text{rn}(d))} \in X$  then  $a \leftarrow a + \alpha_{\vec{\ell}, \vec{j}}^{(\text{rn}(d))} \cdot (b \cdot \varphi_{\ell_d, j_d}^{(\text{rn}(d))}(x_d))$ 
6     if  $\vec{x}_{\vec{\ell}, \vec{j}}^{(\text{ln}(d))} \in X$  then  $a \leftarrow a + \alpha_{\vec{\ell}, \vec{j}}^{(\text{ln}(d))} \cdot (b \cdot \varphi_{\ell_d, j_d}^{(\text{ln}(d))}(x_d))$ 
7   else
8      $a \leftarrow \text{GABF}(X, \vec{\alpha}, \vec{x}, t+1, \vec{\ell}, \vec{j}, b \cdot \varphi_{\ell_t, j_t}(x_t))$   $\rightsquigarrow$  nächste Dimension
9     if  $\vec{x}_{\vec{\ell}, \vec{j}}^{(\text{rn}(t))} \in X$  then  $a \leftarrow a + \text{GABF}(X, \vec{\alpha}, \vec{x}, t+1, \vec{\ell}, \vec{j}^{(\text{rn}(t))}, b \cdot \varphi_{\ell_t, j_t}^{(\text{rn}(t))}(x_t))$ 
10    if  $\vec{x}_{\vec{\ell}, \vec{j}}^{(\text{ln}(t))} \in X$  then  $a \leftarrow a + \text{GABF}(X, \vec{\alpha}, \vec{x}, t+1, \vec{\ell}, \vec{j}^{(\text{ln}(t))}, b \cdot \varphi_{\ell_t, j_t}^{(\text{ln}(t))}(x_t))$ 
11  if  $x_t > j_t h_{\ell_t}$  then  $a \leftarrow a + \text{GABF}(X, \vec{\alpha}, \vec{x}, t, \vec{\ell}^{(\text{rc}(t))}, \vec{j}^{(\text{rc}(t))}, b)$   $\rightsquigarrow$  nächster Level
12  else  $a \leftarrow a + \text{GABF}(X, \vec{\alpha}, \vec{x}, t, \vec{\ell}^{(\text{lc}(t))}, \vec{j}^{(\text{lc}(t))}, b)$ 
13  return  $a$ 

```

ALGORITHM 1.1 Approximative Auswertung von Linearkombinationen auf dünnen Gittern, Zeilen 5, 6, 9, 10 nicht für stückweise lineare Basisfunktionen,
input: Gitter $X = \{\vec{x}_i\}_i$, Koeffizienten $\vec{\alpha} = (\alpha_i)_i$, Auswertungspunkt $\vec{x} \in [0, 1]^d$, aktuelle Dimension $t \in \{1, \dots, d\}$ (anfangs 1), Level und Index $(\vec{\ell}, \vec{j})$ des aktuellen Punkts (für randlose Gitter anfangs (\vec{e}, \vec{e})) und aktuelles Produkt b von 1D-Auswertungen (anfangs 1),
output: $a \approx \tilde{f}(\vec{x}) = \sum_{k=1}^N \alpha_k \varphi_k(\vec{x})$ (für stückweise lineare Funktionen sogar $a = \tilde{f}(\vec{x})$)

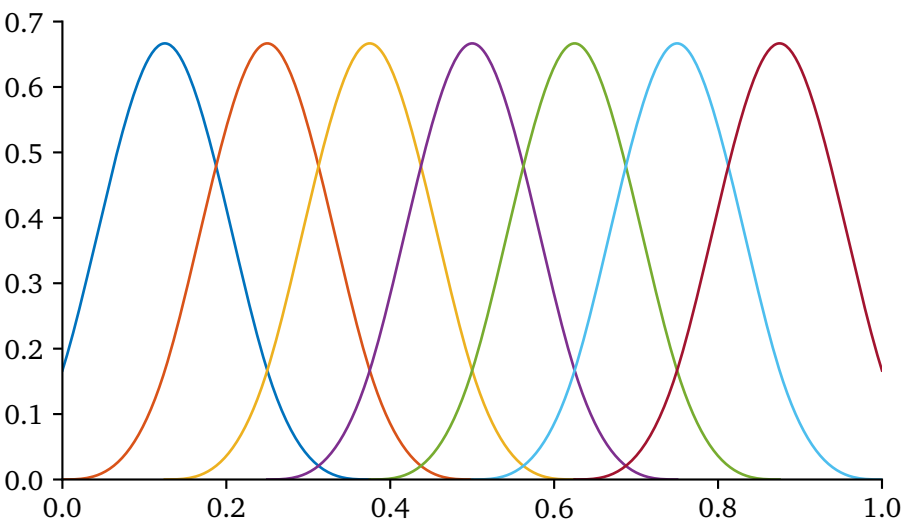


FIGURE 1.2 This is a test caption. This is a test caption. This is a test caption. This is a test caption. This is a test caption. This is a test caption. This is a test caption. This is a test caption. This is a test caption.

is no need for special contents, but the length of words should match the language.
 $\sqrt[n]{a} \cdot \sqrt[n]{b} = \sqrt[n]{ab}$.

LEMMA 1.2 (TODO Lemma)
TODO

Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. $\sin^2(\alpha) + \cos^2(\beta) = 1$. If you read this text, you will get no information $E = mc^2$. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. $\sqrt[n]{a} \cdot \sqrt[n]{b} = \sqrt[n]{ab}$. This text should contain all letters of the alphabet and it should be written in of the original language. $\frac{\sqrt[n]{a}}{\sqrt[n]{b}} = \sqrt[n]{\frac{a}{b}}$. There is no need for special contents, but the length of words should match the language. $a\sqrt[n]{b} = \sqrt[n]{a^n b}$.

DEFINITION 1.3 (TODO Definition)
Hello, here is some text without a meaning. $d\Omega = \sin \vartheta d\vartheta d\varphi$. This text should show what a printed text will look like at this place. If you read this text, you

will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. $\sin^2(\alpha) + \cos^2(\beta) = 1$. This text should contain all letters of the alphabet and it should be written in of the original language $E = mc^2$. There is no need for special contents, but the length of words should match the language. $\sqrt[n]{a} \cdot \sqrt[n]{b} = \sqrt[n]{ab}$.

Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. $\sin^2(\alpha) + \cos^2(\beta) = 1$. If you read this text, you will get no information $E = mc^2$. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. $\sqrt[n]{a} \cdot \sqrt[n]{b} = \sqrt[n]{ab}$. This text should contain all letters of the alphabet and it should be written in of the original language. $\frac{\sqrt[n]{a}}{\sqrt[n]{b}} = \sqrt[n]{\frac{a}{b}}$. There is no need for special contents, but the length of words should match the language. $a \sqrt[n]{b} = \sqrt[n]{a^n b}$.

$$\bar{x} = \frac{1}{n} \sum_{i=1}^{i=n} x_i = \frac{x_1 + x_2 + \dots + x_n}{n}$$

Hello, here is some text without a meaning. $d\Omega = \sin \vartheta d\vartheta d\varphi$. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. $\sin^2(\alpha) + \cos^2(\beta) = 1$. This text should contain all letters of the alphabet and it should be written in of the original language $E = mc^2$. There is no need for special contents, but the length of words should match the language. $\sqrt[n]{a} \cdot \sqrt[n]{b} = \sqrt[n]{ab}$.

$$\int_0^\infty e^{-ax^2} dx = \frac{1}{2} \sqrt{\int_{-\infty}^\infty e^{-ax^2} dx} \int_{-\infty}^\infty e^{-ay^2} dy = \frac{1}{2} \sqrt{\frac{\pi}{a}}$$

Hello, here is some text without a meaning. $\frac{\sqrt[n]{a}}{\sqrt[n]{b}} = \sqrt[n]{\frac{a}{b}}$. This text should show what a printed text will look like at this place. $a\sqrt[n]{b} = \sqrt[n]{a^n b}$. If you read this text, you will get no information. $d\Omega = \sin\vartheta d\vartheta d\varphi$. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special contents, but the length of words should match the language. $\sin^2(\alpha) + \cos^2(\beta) = 1$.

$$\sum_{k=0}^{\infty} a_0 q^k = \lim_{n \rightarrow \infty} \sum_{k=0}^n a_0 q^k = \lim_{n \rightarrow \infty} a_0 \frac{1 - q^{n+1}}{1 - q} = \frac{a_0}{1 - q}$$

Hello, here is some text without a meaning $E = mc^2$. This text should show what a printed text will look like at this place. $\sqrt[n]{a} \cdot \sqrt[n]{b} = \sqrt[n]{ab}$. If you read this text, you will get no information. $\frac{\sqrt[n]{a}}{\sqrt[n]{b}} = \sqrt[n]{\frac{a}{b}}$. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. $a\sqrt[n]{b} = \sqrt[n]{a^n b}$. This text should contain all letters of the alphabet and it should be written in of the original language. $d\Omega = \sin\vartheta d\vartheta d\varphi$. There is no need for special contents, but the length of words should match the language.

$$x_{1,2} = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} = \frac{-p \pm \sqrt{p^2 - 4q}}{2}$$

Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. $\sin^2(\alpha) + \cos^2(\beta) = 1$. If you read this text, you will get no information $E = mc^2$. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. $\sqrt[n]{a} \cdot \sqrt[n]{b} = \sqrt[n]{ab}$. This text should contain all letters of the alphabet and it should be written in of the original language. $\frac{\sqrt[n]{a}}{\sqrt[n]{b}} = \sqrt[n]{\frac{a}{b}}$.

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$$\frac{\partial^2 \Phi}{\partial x^2} + \frac{\partial^2 \Phi}{\partial y^2} + \frac{\partial^2 \Phi}{\partial z^2} = \frac{1}{c^2} \frac{\partial^2 \Phi}{\partial t^2}$$

Hello, here is some text without a meaning. $d\Omega = \sin\vartheta d\vartheta d\varphi$. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. $\sin^2(\alpha) + \cos^2(\beta) = 1$. This text should contain all letters of the alphabet and it should be written in of the original language $E = mc^2$. There is no need for special contents, but the length of words should match the language. $\sqrt[n]{a} \cdot \sqrt[n]{b} = \sqrt[n]{ab}$.

2 Conclusion

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All URLs have last been checked on October 21, 2015.

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