

Witold Jaworski

Virtual Airplane

**Updated for
Blender 2.7**

Third edition



**Create realistic aircraft models
using free software:
Blender, GIMP, and Inkscape**

Virtual Airplane

To my wife
for her forbearance

Witold Jaworski



Virtual Airplane

**Create realistic aircraft models using
free software: Blender, GIMP, and Inkscape**

Third edition

© Witold Jaworski, 2009 - 2015. All rights reserved

wjaworski@airplanes3d.net

<http://www.airplanes3d.net>

ISBN: 978-83-941417-6-9

This book is available in three formats: **PDF**, **EPUB** (3.0), and **MOBI** (KF8). See the format/platform matrix at http://airplanes3d.net/formats-000_e.xml to learn more about the capabilities of these formats on each of the popular reading platforms. To test any of these formats on your device, download the free (Polish) version of this book from the web page of this project: http://airplanes3d.net/wm-000_e.xml.

The picture on previous page:

A pair of P-40B's from 47th USAAC Pursuit Squadron, which managed to take off to fight the Japanese raid on Pearl Harbor, on 7th December, 1941. They were piloted by Kenneth Taylor and George Welch.

At that time 47th PS was practicing gunnery at Haleiwa, a secluded field on the North East corner of Oahu Island. This area was not attacked by Japanese airplanes (Pearl Harbor lies on the opposite side of the Island). The runway ran along the sea coast. This is how the fighters might have appeared shortly after taking off. The background is based on an authentic part of the shore near Haleiwa. *Creation of this scene is described in the last sections of this guide .*

Table of Contents

Why I wrote this book	12
What this book covers	14
Conventions.....	15
How to read this book.....	16
Creating the Model	21
Chapter 1. Software Installation	22
1.1 Blender Installation	23
1.2 GIMP installation	26
1.3 Inkscape installation	27
Chapter 2. Preparation of the Reference Drawings	29
2.1 Preparation of the left side view	30
2.2 Preparation of the right side view	34
2.3 Preparation of the top view.....	42
2.4 Putting it all together.....	54
Chapter 3. Introduction to Blender 3D	57
3.1 Screen layout	58
3.2 3D View — changing current projection	71
3.3 3D View — cameras and object selection.....	82
3.4 3D View – object movement and rotation.....	86
3.5 Properties window	95
Chapter 4. Forming the Model.....	105
4.1 Preparing the Blender file	106
4.2 Propeller spinner	109
4.3 Propeller blade	116
4.4 Wings (the basic shape).....	127
4.5 Wing tip.....	136
4.6 Ailerons.....	145
4.7 Wings (the final shape).....	154
4.8 Horizontal tail.....	159
4.9 Vertical tail	170
4.10 Fuselage (the main part).....	177
4.11 Engine cowling	188
4.12 Radiator cover.....	198
4.13 Engine cowling details.....	204
4.14 Cockpit glass (the rear part).....	214
4.15 Cockpit glass (the forward part)	224
4.16 Cockpit inner structure	236
4.17 Landing gear nacelles	242
4.18 Empennage fairing	253
4.19 Wing root fairing	258
4.20 Other details	266
4.21 Organizing the model	277
Chapter 5. Composition of a Simple Scene	286
5.1 Setting up the camera and lighting.....	287
5.2 Assigning basic materials.....	296
5.3 Creating the scene environment	306
Chapter 6. Texturing Basics	316

6.1	Introduction	317
6.2	Bump maps.....	324
6.3	Mapping meshes in the UV space.....	335
6.4	Bump maps (continued)	342
6.5	Reflectivity (<i>Ref</i>) maps	350
6.6	Summary	357
Chapter 7.	Texturing the Model	359
7.1	Unwrapping the wing	360
7.2	Unwrapping the fuselage.....	371
7.3	Unwrapping other parts of the model	382
7.4	Drawing the surface details	393
7.5	Composing bump maps.....	405
7.6	Composing reflectivity maps.....	412
7.7	Composing color texture.....	425
7.8	Applying markings	440
7.9	Applying other textures.....	449
7.10	Example of a more complex camouflage pattern	458
7.11	Summary	468
Chapter 8.	Detailing the Model	473
8.1	Correcting the fuselage shape	474
8.2	Creating the tail wheel	487
8.3	Mechanization of the tail wheel	500
8.4	Creating main landing gear	511
8.5	Finishing the landing gear	524
8.6	Creating cockpit details	532
8.7	Importing pilot figure	551
8.8	Completion of remaining details	557
8.9	Summary	574
Chapter 9.	Composition of a Final Scene.....	577
9.1	Composing a realistic flight scene.....	578
9.2	Composing a realistic ground scene	592
Details of Programs Usage		605
Chapter 10.	GIMP — Command Reference.....	606
10.1	Installation	607
10.2	Introduction.....	611
10.3	Opening an existing image.....	616
10.4	Saving the image.....	617
10.5	Image cropping.....	619
10.6	Guides	620
10.7	Zooming and panning of the view	621
10.8	Resizing current image	623
10.9	Managing layers	624
10.10	Loading an image file as a new layer	627
10.11	Creating a new (empty) layer	629
10.12	Removing layers	630
10.13	Painting	631
10.14	Erasing.....	633
10.15	Rectangular area selection	634
10.16	Freehand selection	635

10.17	Selection by the pixel color	636
10.18	Extending and shrinking the selected area	637
10.19	Painting the selection	638
10.20	Modifying current selection in the <i>Quick Mask</i> mode	640
10.21	Saving and retrieving selection shape (<i>Channels</i>)	642
10.22	Rotation	643
10.23	Translation	645
10.24	Skewing (<i>Shear</i>)	646
10.25	Scaling	648
10.26	Identifying the RGB values of a color displayed on the screen	650
10.27	Creating a new brush	652
10.28	Defining mouse shortcuts for the brush	655
10.29	Gaussian blur	658
10.30	Painting smoke traces and the other dirt	659
10.31	Drawing scratches and paint chips	663
Chapter 11.	Inkscape — Command Reference	672
11.1	Installation	673
11.2	Introduction	678
11.3	Opening and saving to a file	679
11.4	Resizing current image	680
11.5	Inserting a raster image	681
11.6	Raster image properties	682
11.7	Exporting drawing to a raster image	683
11.8	Zooming and panning the view	684
11.9	Managing layers	685
11.10	Creating a new (empty) layer	686
11.11	Removing layers	687
11.12	Selecting objects	688
11.13	Altering the objects order	690
11.14	Guides	691
11.15	Setting the accurate object position	692
11.16	Drawing a line	693
11.17	Shape properties	694
11.18	Line editing	696
11.19	Curves	697
11.20	Mapping an arc segment	700
11.21	Mapping a curve	701
11.22	Drawing a rectangle	702
11.23	Editing a rectangle	703
11.24	Drawing an ellipse	704
11.25	Editing an ellipse	705
11.26	Translation	706
11.27	Selection frame	707
11.28	Scaling	708
11.29	Rotation	709
11.30	Skewing	710
11.31	Inserting and editing text objects	711
11.32	Bending a text along a curve	713
11.33	Duplicating objects	714

11.34	Drawing a dotted line (rivets)	715
11.35	Precise transformation of an object.....	719
11.36	Moving an object into another layer	720
11.37	Combining objects into a group.....	721
11.38	Filling with a gradient	722
11.39	Mapping the construction details of airplane surfaces	726
11.40	Using filters.....	732
11.41	Mapping the fabric-covered surfaces.....	737
11.42	The dirt effect on the image of aircraft surface.....	741
11.43	Using dedicated True Type fonts.....	748
11.44	Bitmap vectorization	750
Chapter 12.	Blender — General Issues	754
12.1	Installation	755
12.2	Opening Blender files	758
12.3	Saving Blender files	761
12.4	Setting up the work environment.....	763
12.5	Blender configuration files	770
12.6	Importing objects from another Blender file	772
12.7	Autosaving and data recovery.....	774
12.8	Setting 3D Cursor location	776
12.9	Setting reference images in 3D View windows	779
12.10	Managing screen layouts	787
12.11	Managing <i>add-ons</i>	789
12.12	Managing scenes.....	791
12.13	Color selection control	792
12.14	<i>Node Editor</i>	795
12.15	Example of using a second scene	801
12.16	List control.....	805
Chapter 13.	Blender — Object Mode	807
13.1	Switching into <i>Object Mode</i>	808
13.2	Adding a <i>Circle</i>	809
13.3	Adding a square (<i>Plane</i>)	812
13.4	Adding a <i>Cylinder</i>	813
13.5	Adding an <i>Empty</i> object	815
13.6	Adding new light source (<i>Lamp</i>).....	816
13.7	Adding new <i>Camera</i> object	817
13.8	Setting up the <i>Camera</i> properties	818
13.9	Scaling (<i>Scale</i>)	820
13.10	Duplicating objects (<i>Duplicate</i>)	822
13.11	Object naming conventions.....	824
13.12	Assigning objects to the hierarchical model structure (<i>Parent</i>)	826
13.13	Finding the intersection of two arbitrary meshes	828
13.14	Merging selected objects (<i>Join</i>)	832
13.15	Setting the object reference point (<i>Set Origin</i>).....	834
13.16	Temporarily hiding objects (<i>Hide Selected</i>)	835
13.17	Aligning current view to the active object (<i>Align View to Selected</i>)	836
13.18	Assigning objects to layers	837
13.19	Assigning materials to individual objects	838
13.20	Using object display options	839

13.21	Using <i>Armature</i> object	840
13.22	Using <i>Track To</i> constraint.....	846
13.23	Using <i>Locked Track</i> constraint.....	848
13.24	Using <i>Limit Location</i> constraint.....	852
13.25	Using <i>Transformation</i> constraint	854
13.26	Using <i>Stretch To</i> constraint	860
13.27	Using <i>Limit Distance</i> constraint	865
13.28	Creating a <i>Mirror</i> copy	868
13.29	Adding a <i>Curve</i> object	871
13.30	Using the handles control panel (<i>HandlePanel</i>)	876
13.31	Accurate setting of object location	880
13.32	Alternative methods of object selection	883
Chapter 14.	Blender — Edit Mode	885
14.1	Basic terms	886
14.2	Switching into <i>Edit Mode</i>	887
14.3	Selecting mesh elements	888
14.4	Translation (<i>Grab/Move</i>)	893
14.5	Scaling (<i>Scale</i>).....	895
14.6	Rotation (<i>Rotate</i>).....	898
14.7	Extruding mesh elements (<i>Extrude</i>).....	900
14.8	Smoothing meshes using <i>Subdivision Surface</i> modifier	902
14.9	Merging vertices (<i>Remove Doubles</i>).....	905
14.10	Incising new edges on the mesh (<i>Knife</i>).....	906
14.11	Duplicating a mesh fragment (<i>Duplicate</i>).....	908
14.12	Subdividing mesh edges (<i>Subdivide</i>)	909
14.13	Sliding an edge loop (<i>Edge Slide</i>)	910
14.14	Sliding a vertex along adjacent edge (<i>Vertex Slide</i>).....	911
14.15	Inserting a new edge loop (<i>Loop Cut</i>).....	912
14.16	Controlling the sharp edges (<i>Edge Crease</i>)	914
14.17	Removing an edge loop	916
14.18	Removing vertices	917
14.19	Removing edges	918
14.20	Removing faces	919
14.21	Creating a new face	920
14.22	Creating a new edge.....	922
14.23	Merging mesh faces.....	923
14.24	Separating a mesh fragment into new object (<i>Separate</i>)	924
14.25	<i>Mirror</i> modifier.....	926
14.26	Vertex offset (<i>Shrink/Fatten</i>)	928
14.27	Aligning current view to selected mesh elements (<i>Align View to Selected</i>)	931
14.28	Eliminating n-gons from the mesh	932
14.29	Fitting a new bulkhead	933
14.30	Creating a rounded corner	935
14.31	Thickening of mesh surface (<i>Solidify</i>).....	938
14.32	Assigning materials to meshes	939
14.33	Mesh <i>Unwrapping</i>	942
14.34	Projecting onto the UV plane (<i>Project from View</i>)	943
14.35	Defining a <i>Vertex Group</i>	944
14.36	Marking mesh edges as UV seams	946

14.37	Adding an alternate <i>UV Map</i>	948
14.38	<i>Boolean</i> operations	950
14.39	Bending along a <i>Curve</i>	954
14.40	Controlling the influence factor (<i>Weight paint</i>)	957
14.41	Chamfering and rounding edges (<i>Bevel</i>)	960
14.42	Multiplying meshes (<i>Array</i>)	964
14.43	Using textures to deform a mesh (<i>Displace</i>)	966
14.44	Mesh projection on another object (<i>Shrinkwrap</i>)	969
14.45	Controlling face orientation (<i>Normal</i>)	971
14.46	Controlling normal directions along mesh edges	973
14.47	Reshaping objects using auxiliary mesh (<i>Mesh Deform</i>)	978
14.48	Reshaping multiple objects using a single mesh (<i>MDeform</i> add-on)	981
Chapter 15.	Blender — Material Editor (Cycles)	985
15.1	Creating a new material	986
15.2	Introduction to material compositing	988
15.3	Creating node groups	993
15.4	Using a node group	998
15.5	<i>Layer Weight</i> and <i>Fresnel</i> nodes	1000
15.6	Using information about the traced ray type (<i>Light Path</i>)	1006
15.7	Using the <i>Geometry</i> information	1009
15.8	Naming the materials, textures, and node groups	1011
15.9	Using the simplest sky (<i>Sky Texture</i>)	1012
15.10	Creating a light probe	1015
15.11	Transforming coordinates (<i>Mapping</i>)	1017
15.12	Using raster images (<i>Image Texture</i>)	1019
15.13	Using panoramic pictures (<i>Environment Texture</i>)	1021
15.14	Using the <i>Gradient Texture</i> node	1025
15.15	Using procedural “noise” (<i>Noise Texture</i> , <i>Vornoi Texture</i> , <i>Musgrave Texture</i>)	1028
15.16	Placing a background image	1032
15.17	Creating a composite scene environment	1035
15.18	Composing a glass material (<i>Plexiglas</i>)	1045
15.19	Composing a glossy material (<i>Gloss Paint</i>)	1053
15.20	Auxiliary nodes	1061
15.21	Using an alternate UV map (<i>Attribute</i>)	1065
15.22	Using procedural patterns (<i>Wave Texture</i>)	1068
15.23	Using the <i>Texture Coordinate</i> information	1070
15.24	Using the color spectrum (<i>Color Ramp</i>) node	1073
15.25	<i>Curves</i> nodes	1075
15.26	Composing a “general soiling” texture	1077
15.27	Composing a steel material	1083
15.28	Composing a tire material (rubber)	1089
15.29	Composing a leather material	1095
15.30	Composing a textile material (of seat belts)	1102
15.31	Composing a plastic material	1105
Chapter 16.	Blender — UV/Image Editor	1107
16.1	UV mapping basics	1108
16.2	Introduction to <i>UV/Image Editor</i>	1110
16.3	Selecting mesh elements	1112
16.4	2D Cursor	1115

16.5	Translation.....	1117
16.6	Rotation.....	1118
16.7	Scaling.....	1119
16.8	Pinning and unwrapping.....	1121
16.9	Loading and assigning a raster image.....	1123
16.10	Aligning UV vertices (<i>Align</i>).....	1126
16.11	Exporting UV layouts into images.....	1127
16.12	Creating a new (raster) image.....	1131
16.13	Saving raster image.....	1132
16.14	Direct painting on the model surface (<i>Texture Paint</i>).....	1133
Chapter 17.	Blender — Other Issues.....	1143
17.1	Creating new material (<i>Blender Renderer</i>).....	1144
17.2	Antialiasing the rendered image.....	1146
17.3	Helper lines (<i>Grease Pencil</i>).....	1148
17.4	Animation of the propeller rotation.....	1152
17.5	Propeller motion blur.....	1156
17.6	Using <i>Composite Nodes</i>	1159
17.7	Using the <i>Color Balance</i> node.....	1165
17.8	Creating masks from pixel depth values (the Z-pass information).....	1170
17.9	Imitating camera motion blur (<i>Directional Blur</i>).....	1173
17.10	Creating a grassy ground (<i>Particles</i>).....	1179
Appendices	.....	1187
Chapter 18.	Detailed Verification of Aircraft Plans.....	1188
18.1	Comparison with factory drawings.....	1189
18.2	Comparing side view with a photograph.....	1196
18.3	Advanced verification of the top view.....	1206
Chapter 19.	Additional Explanations.....	1213
19.1	Blender data structures.....	1214
19.2	Subdivision Surfaces.....	1220
19.3	Barrel distortion of a photograph.....	1237
19.4	Representation of the airfoil shape.....	1239
19.5	Colors arithmetic.....	1245
19.6	Determining colors of a historical airplane.....	1250
19.7	Light reflections from various materials (<i>IOR</i> and Fresnel coefficient).....	1254
Acknowledgements	.....	1262
Index	.....	1263
Glossary	.....	1335
Bibliography	.....	1337
About the Author	.....	1338

Why I wrote this book

Because I always wanted to create a detailed model of an airplane on the computer. When I finally did it — it proved to be great fun! So I decided to share this experience with others.

A long time ago I was an ordinary modeler, making scale aircraft models. It is a specific hobby. We work hard for many months on our projects. We try to engrave tiny rivets, skin panels, and fine details of the cockpit instruments on our small model. An external observer can conclude that anglers spend their time in a similarly monotonous, but less tiring way. What's more, instead of creating nice, shiny miniatures, we apply to their surfaces (horror of horrors!) trails of dirt and abrasion, to create the impression of intensive usage. We blemish them to look like real, worn, and in some places rusted, machines. Our reward is to show our work to someone who can appreciate its finesse (this can happen from time to time). Strangely enough these evaluators are usually other modelers. Maybe it is just a pretext for the opportunity to discuss such esoteric topics as the superiority of the Spitfire IX over the FW 190 A4? Or the hot issue, how was the P-40K from 23rd FG painted, in which Witold Urbanowicz flew his combat missions over China in 1943?

I would like to offer fellow modelers entirely new materials and tools. Instead of your own desk, sometimes covered with spots of airbrush splashes — a window to another world, in the depths of the computer screen.

In this virtual world you will find an elastic material that can be extruded into any shape. What's more — you will never run out of it! There are paints, for which you can precisely set the colors, shininess, and other properties. It is possible to achieve accuracy there that you cannot get anywhere else, neither in 1:24 nor in 1:18 scale. When you find out that the engine cowling of your old model should have a different shape, you can always correct this error. You can update it many times! Dust will not cover your computer models. You will never hear complaints from your family that there is no place for your growing collection. You can also create many variants of your airplane (each of them in a different camouflage, for example). Your models can be sent to other hobbyists like yourself, without fear that something will happen to them during transport. You can also quickly build up a whole scene, using your planes.

The only thing you have to get used to, is that you cannot touch anything in this virtual world. You can only select visible objects with the mouse. More advanced haptic devices are still expensive and primitive, at least at the present stage of the technology development. On the other hand, we currently observe fast development of inexpensive 3D printers. I expect that in the near future you will be able to print on these devices parts of your computer models.

This world of virtual modeling sneaked into reality in the middle of the past decade. In fact, every computer produced after 2005 is a fully equipped graphics workstation. (You could only dream about such a computing power in the previous century). In 1997 a new mathematical model for surface modeling entered the scene. It is called "subdivision surfaces" (or, shorter: "SubD"). This technology allowed the first computer animation studios (like Pixar) to create Shrek and dozens of other cartoon characters. In the future, subdivision surfaces may replace the older NURBS solution in CAD/CAM systems. Using the SubD you can create very complex shapes (like a whole dinosaur, or complete engine block, for example). This mathematical tool copes well with holes and cut-outs. (Such features are not "natural" for the NURBS surfaces. The NURBS-based CAD/CAM systems still have troubles with special cases of fillets and holes. They were programmer's nightmare).

What's more, software which uses all these technologies became available for free! It has been created by hundreds of Open Source programmers. These people want to show that they can be at least as good as their best commercial counterparts, and they have begun to achieve it! Maybe they are driven by the pure intellectual challenge ("I'll do it better!"). Such volunteer projects have also a different pace of coding: there is no rush in this work. On the contrary, tight schedules are always present in typical commercial enterprises. These deadlines are the primary cause of many errors. In effect, a large enough group of enthusiasts (in Open Source they often call it "the critical mass") can create a good, stable program.

To sum up — buying an ordinary computer for games, you have bought everything you need to enter the new world of virtual modeling. I will not cheat you: one inherent thing in the work of every modeler is still present here. Creation of an accurate computer model requires several weeks of hard effort, just like its real-world counterpart. However, I wrote this book to help you, dear Reader, in reaching the desired results faster. Then you can go ahead and do the same thing even better than I suggest here. Reading the following pages will save you a lot of time, and — sometimes — plenty of frustration. The latter is usually an integral component of working with “this stupid machine”: the computer. I will try not to bore you, and will show plenty of pictures. I hope that you will find this book interesting.

Witold Jaworski

What this book covers

“Virtual Airplane” teaches you how to create the model, shown on the cover page. To begin this course, just average computer skills and some knowledge of Windows are required. You need no previous experience in computer graphics (although such experience will allow you to skip some of the basic subjects, described here). This book shows the method of modeling an airplane from World War II. It is described step by step, in full detail. I have decided to show it on the example of the Curtiss P-40 fighter. Its design contains typical features used in most aircraft of this period. I chose it because I do not want to deprive you the pleasure of building models of the famous fighters such as the Spitfire, Mustang, Thunderbolt, Focke-Wulf, or the Messerschmitt!

- You can use the methods presented in this book to create any Second World War fighter¹ model. It does not have to be the P-40, as all of these airplanes had a similar design. In the course of this work you will encounter most of the modeling problems, both described and solved here.

“Virtual Airplane” is intended for those who are just beginning their adventure in the “3D”, as well as for those, who have already some experience on this field. Therefore, I decided to divide it into two parts:

- the first part (“Creating the Model”) contains the main text, which describes **what** you should do;
- the second part (“Details of Programs Usage”) contains detailed descriptions of **how** to use particular software to obtain the results shown in the first part.

The pages of “Details of Programs Usage” span over half of this book. The contents of this second part resembles a context help scheme. It contains plenty of short sections (one or two pages per section), containing no more than a few illustrations. Each of them describes details (keyboard shortcuts, menu commands, results) of a single operation.

Dividing the material of this book between the basic and detailed part, I tried to avoid excessive details in the main text, like “click this button, select this item”. Such hints, although needed, make the narration longer and obscure. In the first part, where appropriate, I placed links to the second part of this book. If you are new to the program which is used in the main text, just follow these links to the detailed descriptions of every operation². I prepared chapters of the main text in a sequence that will let you gradually learn all of these tools. Once you know **how** to do what I am describing — just stop using these shortcuts.

This book also has a third part: “Appendices”. These additional chapters contain a “hodgepodge” of many different articles: discussion of some optic phenomena (like barrel distortion of the image on a photograph, or the light refraction), a color theory for CG, and an airfoil geometry details. This part also contains a review of advanced methods for blueprint verification (on the level that allows you to create improved scale plans), and details of subdivision surfaces mathematics. All of these materials are optional, although I think that they may help you in better understanding some issues mentioned in the main text (“Creating the Model”).

¹ Well, at least those which used inline engines. I have not described here how to model the externally visible components of air-cooled radial engine. All these cylinders, rods and tubes... Maybe I would include a P-36 model, in the next edition of this book?

² I assume that the use of the second part will always be random. Thus most of its basic sections contain text without further references. This approach means that, for example, the description of the scaling in Blender [Mesh Editor](#) is almost a verbatim copy of the description of similar operation in the [Object Editor](#). They differ only in the illustrations and a few sentences. I just do not know which of these topics you will open as the first one, so each of them provides all the information you need.

Conventions

For the tips about using the keyboard and the mouse I have assumed that you have a standard:

- US keyboard, with 102 keys (you will find in this book some comments about non-standard laptop keyboards);
- Three-button mouse (in fact: two buttons and the wheel in the middle. When you click the mouse wheel, it acts like the third button).

Command invocations are marked as follows:

Menu→*Command* means invoking a command named *Command* from a menu named *Menu*. More arrows may appear, when the menus are nested!

Panel:Button means clicking a button named *Button* in a dialog window or a panel named *Panel*. Panels are parts of Blender screen (for more explanation — see page 95). Sometimes I may also mention other dialog controls, like a checkbox or a drop-down list.

Pressing a key on the keyboard:

Alt-K the dash (“-“) between characters means that both keys should be simultaneously pressed on the keyboard. In this example: while holding down the **Alt** key, press the **K** key;

G, X the comma (“,“) between characters means, that keys are pressed (and released!) one after another. In this example type **G** first, then **X** (as if you would type “gx”).

Pressing one of the mouse buttons:

LMB left mouse button
RMB right mouse button
MMB middle mouse button (mouse wheel **pressed**)
MW mouse wheel (when it is **scrolled**)

Last, but not least — the formal question: how should I address you? The impersonal form (“something is done”) is used in most of the guides. I think that it makes the text less comprehensible. To keep this book as readable as possible, I address the Reader in the second person (“do it”). Sometimes I also use the first person (“I’ve done it”, “we did it”). It is easier for me to describe my methods of work in this way¹.

¹ While working on this model I thought about us — you, dear Reader, and me, writing these words — as a single team. Maybe an imaginary one, but somehow true. At least, writing this book I knew that I had to properly explain to you every topic, with all details!

How to read this book

This guide is a digital publication. To make it more readable than a classic book, I moved most of the detailed instructions out of the main text, leaving their hypertext references. Use them for “digging into details” and then jump back to the general subject. To avoid “cluttering” the text, these links are not distinguished either by the color or by underline. You can recognize them by the context (“see page ...”) and the behavior of the mouse pointer. When you hover over a link, its shape changes into a “pointing hand” (Figure 1.1.1):

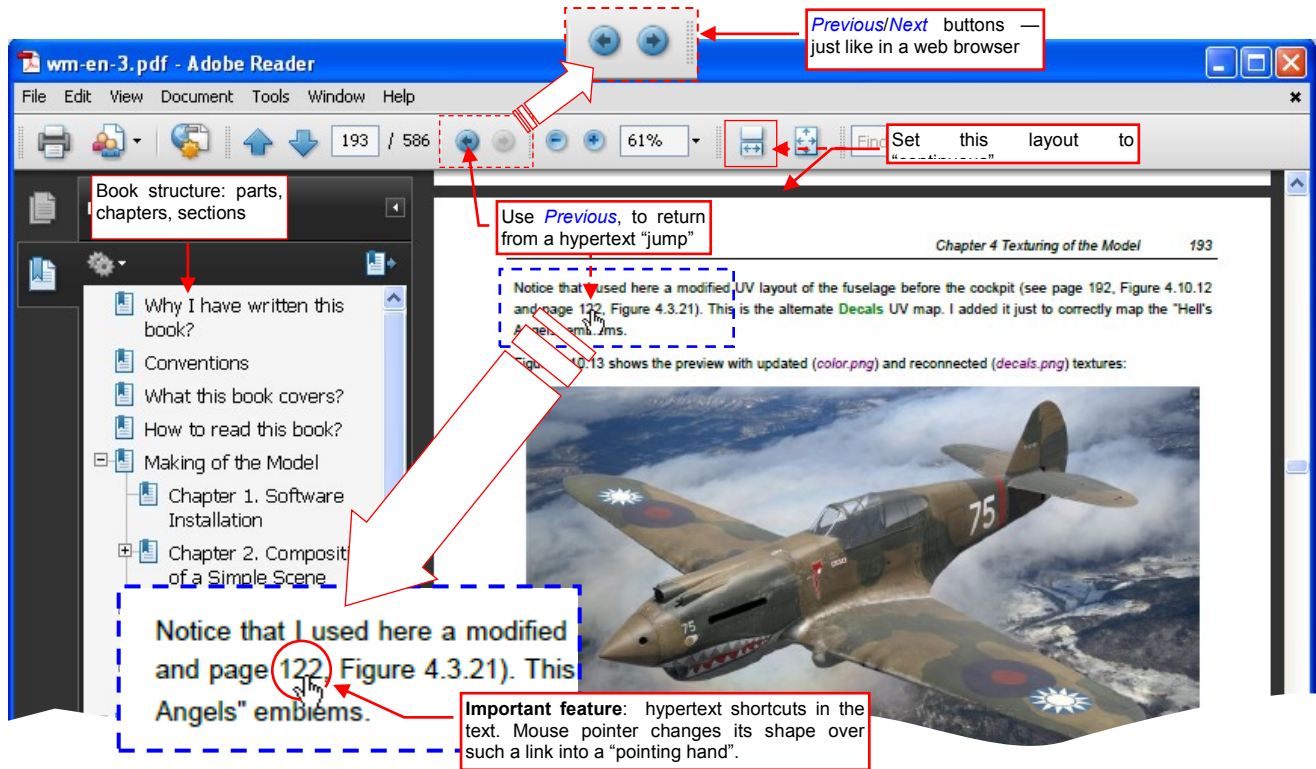


Figure 1.1.1 Reading this book in a PDF reader (Adobe Reader)

Click the link, to go to the referenced page. To return to the previous location, use the *Previous/Next* buttons. In Figure 1.1.1 they are located on the toolbar at the top of the screen, and work just like in the web browser. To make subsequent pages more readable in your PDF reader, you can also switch their display mode to “continuous” (Figure 1.1.1). I think that this mode is better for online reading.

I tried to make this PDF document as portable as possible, thus I published it in so-called PDF/A format (it contains embedded fonts and color information). Be aware that the popular **Adobe Reader** by default ignores all hypertext links in such files (Figure 1.1.2):

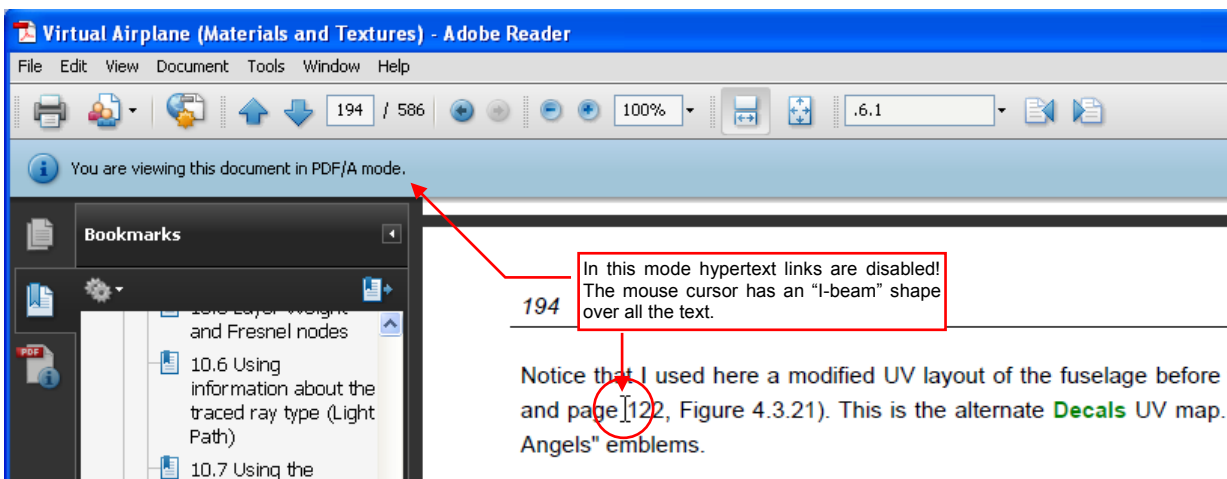


Figure 1.1.2 Inactive hyperlinks in the PDF/A mode (Adobe Reader).

To enable hypertext links in a PDF/A document, you have to change **Adobe Reader Documents** settings (Figure 1.1.3):

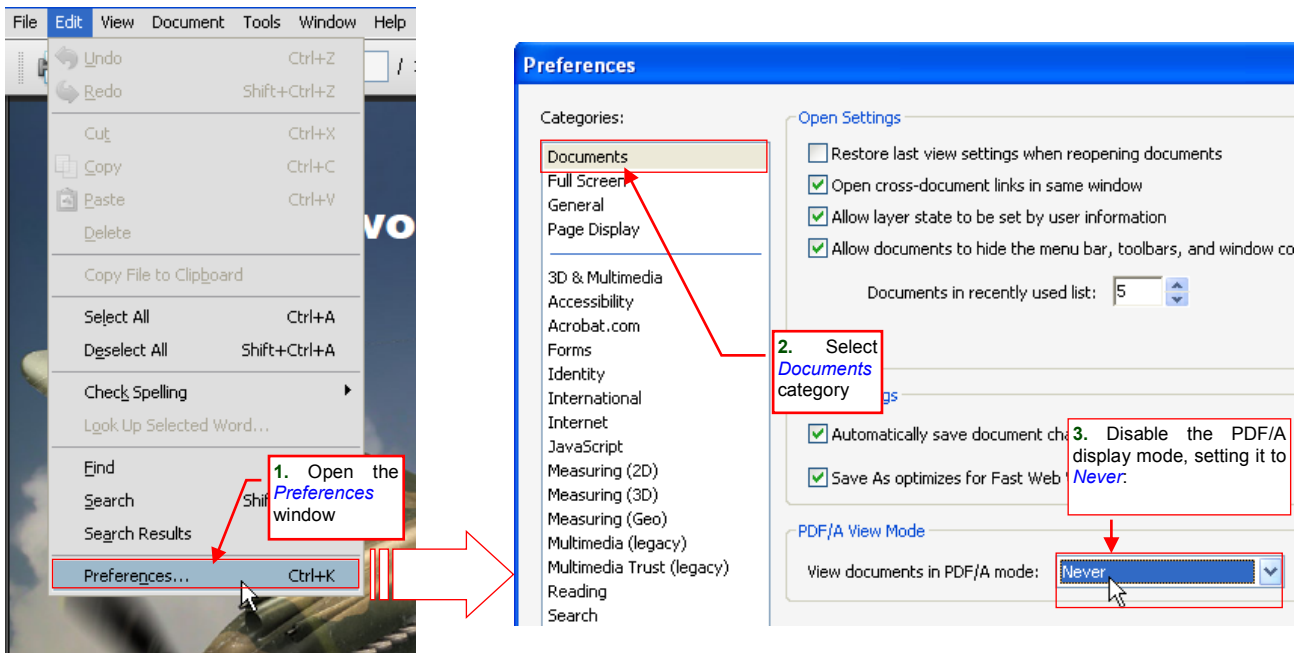


Figure 1.1.3 Enabling hypertext links for this document (Adobe Reader, version 9.0)

Open the **Preferences** dialog window from the **Edit** menu. Select **Documents** on the category list. This brings up appropriate controls on the right side of the window, as shown in Figure 1.1.3. Disable the **PDF/A View Mode** selecting **Never** from its drop-down list.

Subsequent versions of **Adobe Reader** differ from each other. For example their toolbar may appear at the bottom the screen (as it happened to the version 8.0). What's more, the **Previous/Next** buttons, useful during the hypertext "jumps", may be absent in the default configuration of this program (Figure 1.1.4):

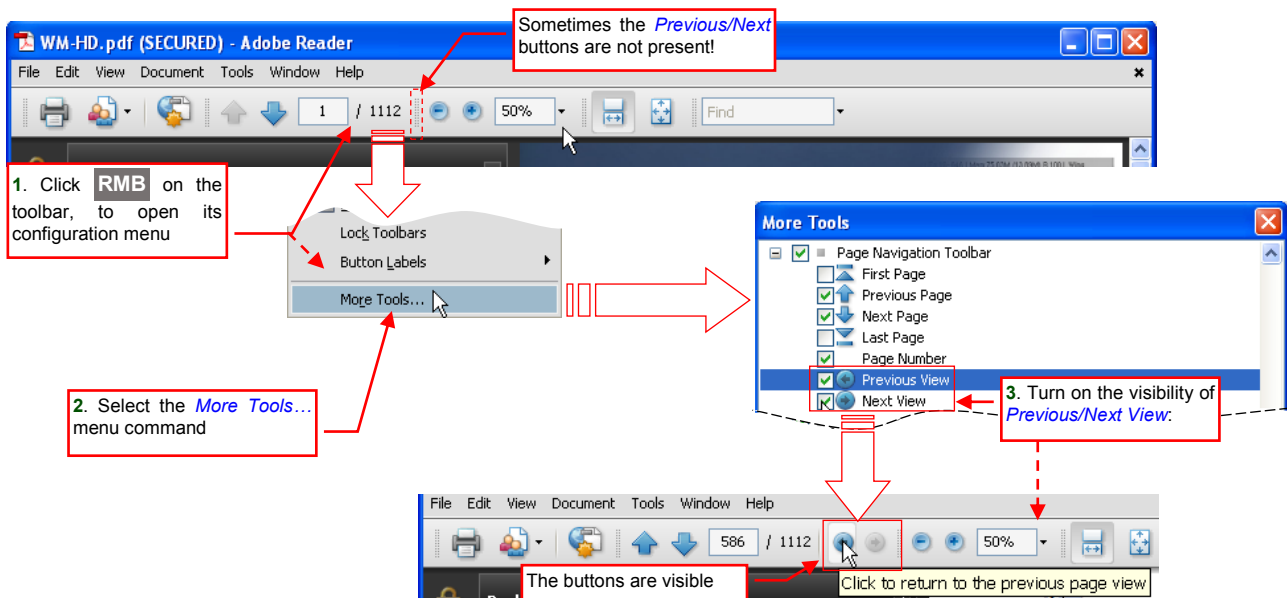


Figure 1.1.4 Adding the **Previous/Next** buttons to the toolbar (Adobe Reader).

Although you can always use the keyboard shortcuts (**Previous**: **Alt** - **←**, **Next**: **Alt** - **→**), it is always better to see these buttons. Click **RMB** on the toolbar, to pull down its context menu, and invoke from it the **More Tools...** command. In the **More Tools** window find and mark the **Previous View** and **Next View** items. It will bring the buttons back to the toolbar (Figure 1.1.4).

In this book, illustrations are very important. You can find them on almost every page. (Actually, this guide can be described as a partial “comic book”). Unfortunately, their presence significantly increases the PDF file size. To keep it to a reasonable level, I had to turn on image compression, which decreases the quality (especially the vivid red color of the model materials). What you see is the result of a compromise between the file size and the accuracy of the pictures it contains. For **Adobe Reader** I would suggest altering a few parameters which can improve the quality of these illustrations. They are not set by default, so you will have to change them manually in the configuration of this program (Figure 1.1.5):

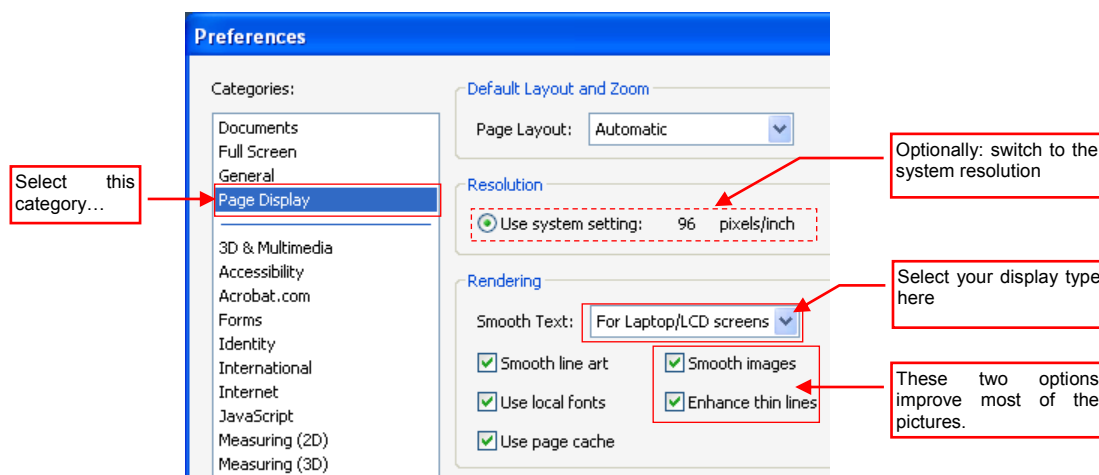


Figure 1.1.5 Optional settings, to improve the display quality of document images (Adobe Reader version 9.0)

In the *Preferences* dialog select from the list the *Page Display* category. This brings up appropriate controls on the right side of the window, as shown in Figure 1.1.5. Select the appropriate text smoothing method from the *Smooth Text* list. (The *Monitor* mode is selected by default). Perhaps you are using a kind of LCD computer display. In such case you should select the *For Laptop/LCD screens* option.

In addition, in the *Resolution* area you can also select the *Use system setting* option. (The other option — *110 pixels/inch* — is selected by default). Personally, I think that the pictures look better in this “system resolution”¹. Do not worry if in your program you can see a different value than the 96 pixels/inch (Figure 1.1.5). It depends on the text size, which you have set up in your Windows system settings.

Finally, in the *Rendering* area there are two check boxes: *Smooth images* and *Enhance thin lines*. In most cases you should keep them turned on (as in default settings). However, if the airplane on the cover image of this book has slightly wavy edges on the wings, you can try to disable these image anti-aliasing settings. Decide yourself, whether it looks better without these options.

* * *

You may always print a copy of this book for your own use. However, it is also possible to read it directly from the screen, while working on the model. In the latter case you can save some paper, preserving a few more trees in this way. What’s more, you will have all the detailed descriptions at hand, through the hypertext links. Of course, if you prefer to page through a traditional, paper book — print all its pages². Even if your printer supports duplex printing, you have to prepare an entire ream of A4 sheets for the full book! I assure you that this was not my intention ☺.

* * *

¹ In this resolution the letters are somewhat smaller. It is especially obvious in the callouts, placed on the images!

² This e-book contains all pictures in color. Therefore, many of them will have a low contrast in the print. As a remedy for this effect, I changed the color of callouts on some illustrations to darker or lighter one. It makes them to look better, when they are printed on a mono-chrome printer.

"Virtual Airplane" is also available in other popular eBook formats: **EPUB** and **MOBI**. However, **PDF** is the best format of this book for **Android** tablets (in this form it is available on Google Play)¹. As the reader program on this platform I also recommend **Adobe Reader** (Figure 1.1.6):

20

Creating the Model

Now let's check whether the image is rotated or skewed. Place guides (details — see page 59) on the key lines of design, that should be vertical or horizontal (Figure 2.1.2):

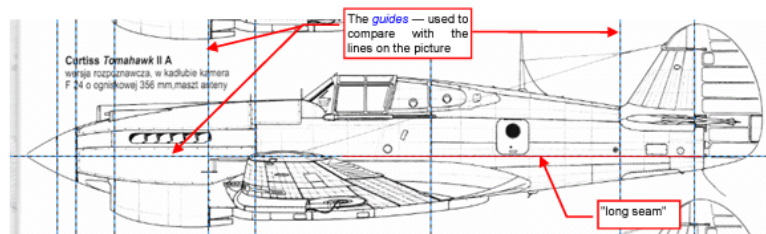


Figure 2.1.2 Guides, used to find eventual deformations

Perhaps you would like to ask, how do I know that these particular seam lines on the P-40 fuselage were horizontal or vertical. Well, there is no precise answer. Let's start with the horizontal ones. At each drawing, and many photos you can see on the fuselage a long seam of panels, extended from the tail to the firewall. (Figure 2.1.2). This line goes slightly below the propeller axis. In the aircraft technical description you can read that the P-40 fuselage was made of two halves: the top and the bottom. What's more, there are photos of reconstruction of a P-40N (made in New Zealand), where you can see that the edge of the top half runs exactly along this seam. These two halves overlap each other along their seam line. The edge of the top part covers about one

Figure 1.1.6 Reading this book on Android tablet (in Adobe Reader, version 11)

Comparing to the PC version (presented earlier in this section), this **Adobe Reader** has a simplified user interface and a minimum number of options (Figure 1.1.7):

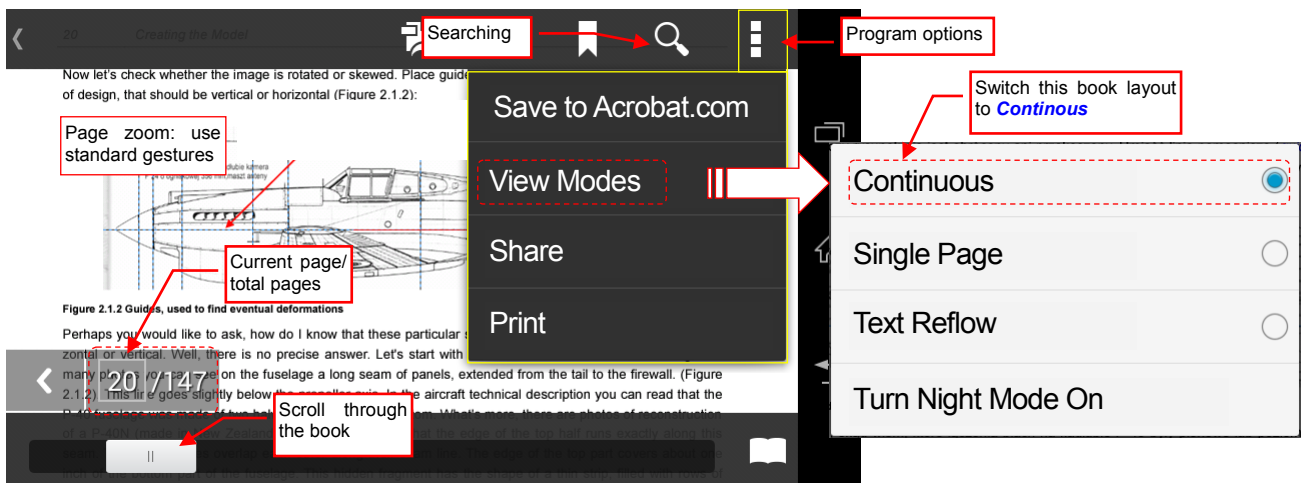


Figure 1.1.7 Adobe Reader user interface (Android)

Fortunately, you can still set here a continuous page layout (**View Modes** → **Continuous**, see Figure 1.1.7). This option is especially useful for displays of smaller size.

¹ **MOBI** is a proprietary book format of Amazon.com. In principle, **EPUB** is an open format supported by most readers. However, "in principle" does not mean "always". When I was looking for an EPUB-reader which I could recommend for tablets running **Android**, I think I tried most of the free apps that I found on Google Play. No one of them displayed properly the *.epub file of this book. Why? The contents of a typical e-book is displayed as so-called flowable text. An e-book reader fits these paragraphs into available screen area (in a similar way as web browser fits contents of web pages into its window). The "Virtual Airplane" illustrations contains a lot of explanations. To easily read this book, the font size of these explanations should be unified across whole text. To provide this effect, illustrations had to dynamically fit to a reader screen. Although I use for this purpose a method (style) documented in the EPUB 3.0 specification, it turns out that many of readers, especially those for **Android** system, cannot cope with this effect. In this situation, I decided to deliver this book in the **EPUB** format only to **iPads** (via Apple Store, optimized for the popular **iBooks** reader) and PC. I do not want to deliver it to other devices in a format that may be incorrectly displayed.

In this “mobile” **Adobe Reader** you can also use the internal hypertext links. However, on the touch screens of **Android** devices there is no cursor which changes shape over such a link. Keep in mind that every reference to a page number, figure or chapter contains such a reference. Just tap the relevant text (Figure 1.1.8):

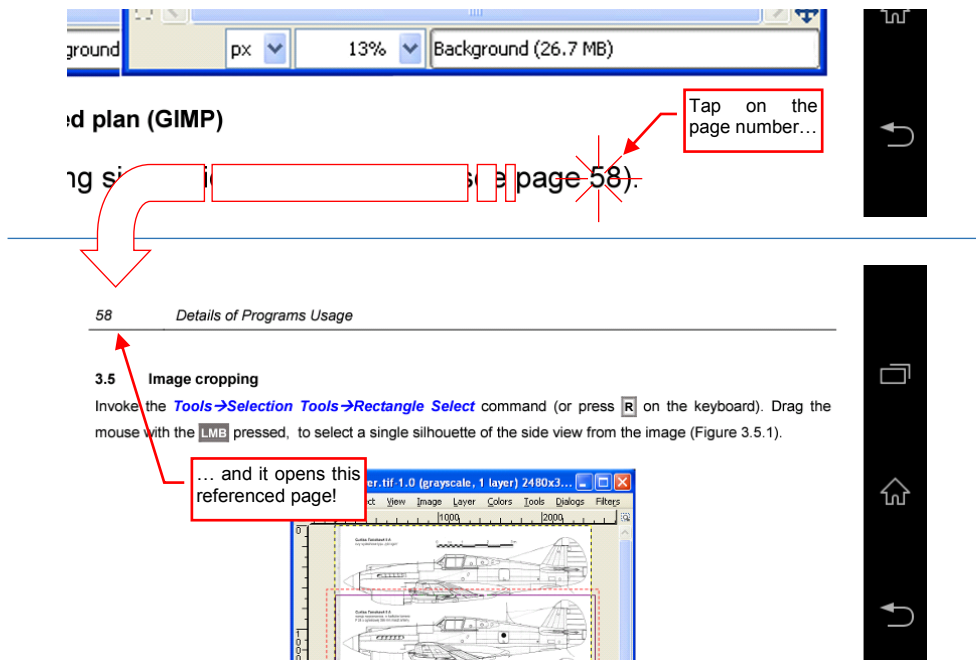


Figure 1.1.8 Using the internal hypertext references

To return from such a "hypertext jump" to the previous location, use the “<” button, which appears on the right (near the page number — Figure 1.1.9):

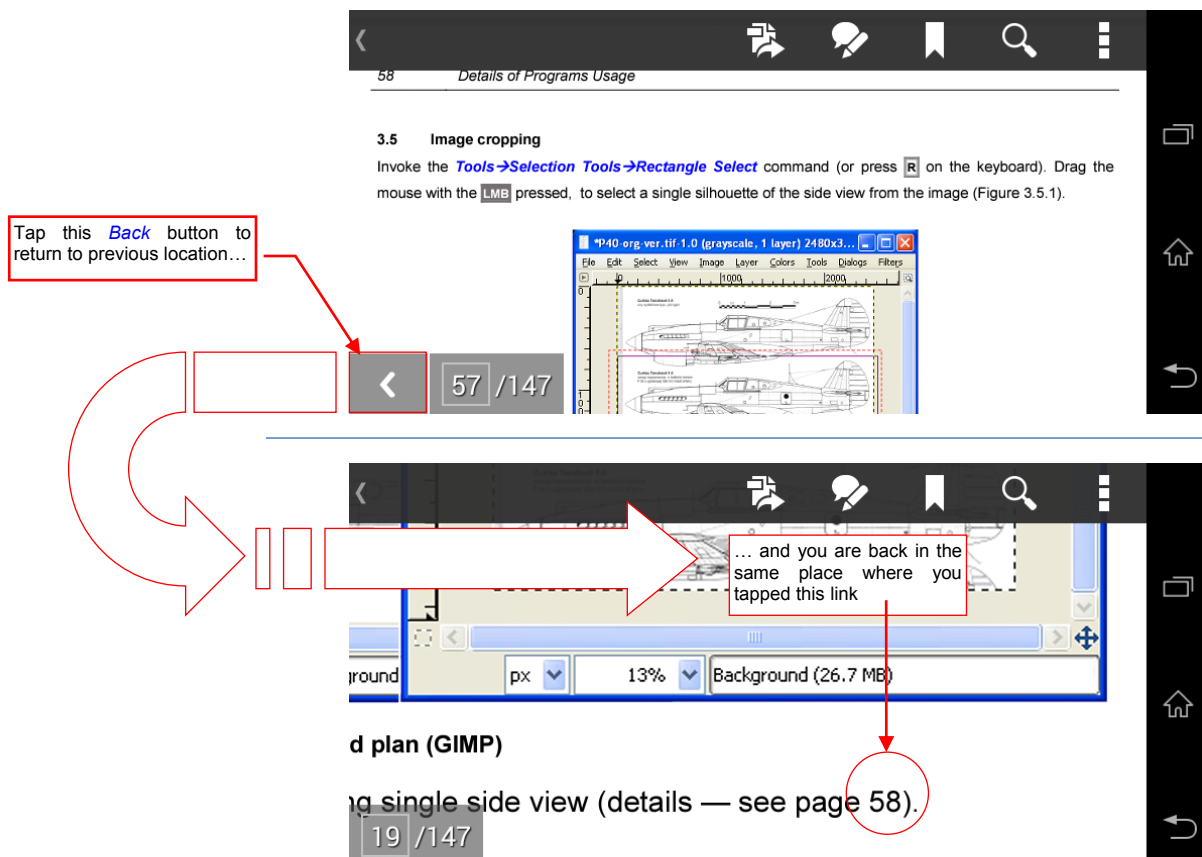


Figure 1.1.9 Returning from referenced page

- **Adobe Reader** for iOS (**iPad**) has no *Back* button, which makes it practically useless for this book.

In the 20th century you could make an aircraft model from paper or plastic. In the 21st century the time has come for yet another variation of this hobby: computer models. The birth of this new branch of scale modeling was unnoticed. Few people could spend several thousand dollars of their private money buying a complete 3D design environment just for amusement. In the first years of this century the only alternative was the use of an “inappropriate” software — nothing to boast about... So the first enthusiasts were quietly sitting at their monitors and creating models, learning from their own mistakes.

The times are changing, and now all the necessary software is available for free (it is GPL-licensed). So if you bought your computer less than 6 years ago, you have everything you need to get started! This book provides the essential know-how. I will show you step by step, how to make such models as the P-40 shown on this cover.

“Virtual Airplane” was written not only for the scale modelers. It may also be useful to all who want to learn the three most popular Open Source graphic programs: Blender, GIMP, and Inkscape.



Visit www.airplanes3d.net to ask a question or obtain free trails!

ISBN: 978-83-941417-6-9



A P-40B from the 3rd squadron of AVG („Hell's Angels”), Kunming 1942. (Background photo: © Tomo Yun, www.yunphoto.net)