

# Words for 3-D Vision

Nie Shicong

June 30, 2020

# Contents

Linear Algebra Done Right	1
1 Chapter 2 & Chapter 3	3
2 Chapter 4	4
MVG Lecture 8, 9, 10	5
3 Chapter 5	6
4 Chapter 8	7
5 Direct approaches for Visual SLAM	8
6 Chapter 11	8
7 Review	10
8 Introduction to Linear Algebra	10
9 Toefl Listening	11
10 Miscellaneous	14
11 slam	37
12 Introduction to Algorithms	49

## Linear Algebra Done Right

audacious  
torturous  
banish  
make up for ...  
in a fasion  
genuine / formal  
, due to the next class

without charge  
I'm no longer around  
first brush  
immerse yourself in ...  
an emphasize on attaining ...  
zip through a page  
on your part  
ponder  
internalize  
without regard to ...  
owe a debt  
heritage  
antiquity  
Bestowing proper credit on ...  
undertake  
In no case should ...  
dispense with  
clutter  
vague  
as rigorously defined as  
philosophy  
lurk  
proposition  
corollary  
once and for all  
be enlarged with  
triplet  
transport  
paralelepiped  
Roughly speaking, ...  
anticipate  
derive / derivation  
refer to ...as ...  
instantaneous / spontaneous  
be doomed to ...

# 1 Chapter 2 & Chapter 3

rudiment / rudimentary

In a broad figurative sense

frescoe

mosaic

landscape

It's no coincidence

proficient

matter

vibrant

compelling

rather sophisticated

indicative

portray

graph

irradiance

by no means trivial

diffraction / refraction / reflection

germane

we can argue with

emit

cone

negligible

undeflected

upside down

subtend

radiance flux

consist in ...

compensate

...outlined above

...thus obtained

articulate / articulation

aberration

counterpart

## 2 Chapter 4

reconcile  
at the outset  
moreover  
discern / discernible  
presumably  
photom  
discrepancy  
corrupt  
manifestation  
counteract  
envision  
opaque  
suggestive  
cardinality  
count on ...  
conceive  
rephrase  
lend itself to ...  
lump  
departure  
scatter  
ambient  
translucent  
anisotropic  
commonplace  
hint  
How do we proceed ?  
ill / well posed  
an abuse of notation  
tilde / wiggle  
identical  
more diagonally  
moderate  
nonuniform  
, irrespective of ...  
...made of ...

regard ...as ...  
decent  
curvature  
marble  
distinctive  
elucidate  
extended  
qualitative / quantitative  
diffuse  
warp  
substantial  
prune (out)  
pyramid  
jerk  
whilst  
shearing  
field  
even if  
chameleon  
specularity / specular  
among other things  
mega  
heuristic / heuristics  
discriminate / discriminative  
mannequin  
dummy  
doable  
stroboscope  
agenda  
alternate among / between  
side benefit / effect

## **MVG Lecture 8, 9, 10**

fascinating  
pursue

schematic  
involved  
suboptimal  
haunt  
recipe  
reasoning  
inference  
pathological  
chances are that ...  
reminiscent of ...  
...mingled with ...  
derive / derived / derivation  
bombastic

### 3 Chapter 5

unveil  
photogrammetry  
Without loss of generality / continuity  
characterization  
sufficiency / necessity  
draw attention to the case that ...  
three out of the four ...  
parallax  
exercise caution to ...  
be of more significance for ...  
bury  
uncontroversial  
universally accepted  
probable / improbable  
When combined with, ...  
In what follows, ...  
oversight  
In the remainder of ...  
multimodal  
optimality

## 4 Chapter 8

panoramic / panorama

at most

taxonomy

gross errors

pertain to

thesaurus

suspicion

be promoted by ...

quadrilinear

annihilate

quadruple

clarify / clarity / for clarity

rectilinear

glimpse

perturb

synthesis

concave

crank up

isoline

asymptotic

be inferior to

zig-zag

contract

paraboloid

provided (that)

in this regime

revert to

profit from

extremality / extremity

quasi

damp

overlook

be (all) set to go



silhouette  
contour  
a whole lot  
monocular  
footage  
circumvent

## 5 Direct approaches for Visual SLAM

invariably  
devastate  
deteriorate  
degrade  
nuisance  
sideways  
close by  
soap films  
in-between  
revision  
residuum / residual  
voxel  
more or less  
alleviate

## 6 Chapter 11

multifaceted  
irregular  
polygonal  
so as to ...  
convolve  
forcibly  
suppress  
tile

disparate  
elaborate  
contrast  
sawtooth  
aliasing  
sinusoidal / sinusoid  
convey  
transmission  
adequate  
waveform  
ego-motion / ego / egoistic / egoistical  
primitive  
multiscale  
superpose  
be similar in spirit to ...  
compromise  
macroscopic  
rationale  
caveat  
radically  
forego  
laden  
be reputed to ...  
putative  
orphan  
underlying  
be free of ...  
handful of ...  
render sth. be  
settle for sth.  
set up  
two orders of magnitude  
uneven  
play with ...  
in place of ...  
extrapolate  
convex hull  
carve

tetrahedra  
prism  
arch  
surfaces of revolution  
bookkeeping  
entail

## 7 Review

long known  
indispensable  
rational / rational number  
quotient

## 8 Introduction to Linear Algebra

all-important / vitally important / crucial  
hammer away at the difference between ...and ...  
...back off from ...  
seesaw / teeterboard  
spreadsheet  
This is more than ...  
at once / at the same time  
stand for ...  
either way  
humble  
fall into place  
The odds are ...  
basic facts  
regard ...as ...  
common sense  
magician  
sweep  
provision

subroutine  
abnormal

## 9 Toefl Listening

folk / fairy tale  
act out  
narrate  
props  
scenery  
be disillusioned with  
be grappling with  
symbolize  
seemingly  
unsolvable  
turmoil  
bare  
...be a departure from ...  
make us see  
be swept up  
I'd love / like to ...  
...be the same ...as ...  
the significance difference is with ...  
costume  
...be teeming with ...  
organism  
...get as much popular attention as ...  
whale  
microscopic  
algae  
...aren't as exciting  
bulk, bulk of ...  
plankton  
fresh water  
mystery  
not the way birds do

must  
commute / commuting  
stimulus / stimuli  
sun's rays  
barely  
penetrate  
away from  
sunlight  
head back toward ...  
illuminate  
expend  
predator / predator avoidance  
Make sense, doesn't it ?  
But what do we do with ...?  
at great depth  
light up  
bioluminescent  
despite all these  
by sight  
presence and absence  
prey / prey on  
ultra-violet  
conserve  
feeding  
digest  
archaeology  
go out into the field  
shovel  
an array of  
inter-disciplinary / multi-disciplinary  
muon  
...result from ...  
subatomic  
start over  
basically  
proton  
zip through  
outer space

be critical for ...  
be closely based on ...  
occasionally  
hardly ever ...anymore  
originally  
controversial  
filmmaker  
purity  
over time  
orchestra  
if wanted  
drum, rolling of drums  
...or whatever  
But that wasn't as common  
..., the ones concerned about  
Trouble is(was), ...  
the luster wears off  
commerce  
was it ever ?  
the commercial types  
now that ...  
visual medium  
stage  
straight adaptations from ...  
since ...  
all they pretty much did was ...  
on the mark  
nonsynchronous  
expressive  
have experience with ...  
live radio  
technician  
...that makes sense to them  
less obvious  
Anyway, ...  
look at this in various ways  
radical  
advocate

a bit of an exaggeration  
What meant to say was ...  
making money  
proliferate / proliferation

## 10 Miscellaneous

striving / strive  
grand goals  
core mission  
non-profit  
fuel ...  
openly  
sponsor  
editorial publications  
across the world  
workshop  
panel / panelist  
webinar  
mailing-list  
newsletter  
disseminate  
more collaborative / inclusive  
have sb. on-board  
curate  
advisory board  
enthusiast  
at scale  
alchemist  
predictive maintenance  
schedule a meeting / call  
quota  
coffee break  
poster  
interface a new problem with ...  
peer, peer review, peer pressure

be articulated in two phases  
announce / announcement  
adherence to .../ adherent  
final aggregation score  
ever more  
exclusively focus on ...  
memory overhead  
take / draw inspiration from ...  
disentangle  
a surge of  
mediate, be mediated by ...  
neurocognitive  
sensorimotor  
remain a long-standing challenge for ...  
...factor in ...  
curriculum  
progressively / progressive  
over long time spans  
interfere with ...  
abrupt / abruptly  
excel = be master of .../ excel at ...  
a batch of  
pragmatic pragmatically  
hinder  
methodology  
developmental  
in scenarios of ...  
timely  
refine / refinement  
on the basis of ...  
mammal / mammalian  
throughout the lifespan  
contingency  
sustainable / sustainability  
sustained = continuous  
neurophysiological / neurophysiology  
visiting student  
eligible



democratic / democracy  
...be made possible with / by ...  
consultant  
lineup  
given  
on a daily basis / on a regular basis  
cutting edge  
underway  
initiative  
hub of information  
didactic  
avalanche  
with ...in mind  
value ...  
showcasing  
venue  
cause  
bibliography / bibliographic  
hiccup  
antithetical  
antipodal  
utterly  
nerve ...  
bombard / be bombarded with ...  
arrange = lay out  
as originally conceived  
living creatures  
be adept with ...  
repurpose  
in some ad hoc way  
dispute  
in any case  
self-imposed  
submarine  
harness the power  
towards its own purposes  
steer  
accrue

brilliant, a brilliant idea  
metaphor  
corollary  
teleoperation  
rebel / rebellion  
be constantly changing / evolving  
regularity  
a rough idea  
string  
transpire  
unfold  
at its own pace  
prose  
sensible  
unorthodox  
peg, pegged to ...  
entrust  
probe  
waterfall  
definitive  
cascade  
tailor, be tailored to ...  
diploma  
cohort, a diverse cohort of ...  
attest / attested  
defer  
transcript  
comparable  
proficiency / proficient  
postsecondary  
ivy  
a huge time commitment  
rigorous  
embark  
accredit / accredited  
phenomenal  
in no way  
disrupt / disruption

breadth  
demonstrated leadership  
deposit  
flush  
await / be awaiting  
turtle / tortoise  
carnivorous / herbivores  
imperative  
pervasive  
scavenge / scavenger  
refrain from ...  
scarcity of ...  
sensitization  
habituation  
exposure  
a well lit room  
reciprocal  
retreat into ...  
secrete  
ion  
astounding  
finer  
acuity  
causal / casual  
differentiate  
conditioning  
be made famous by ...  
saliva / salivate  
..., as such in the example of ...  
cattle  
deter ...from ...  
in the wild  
uncover  
inhibit / inhibition  
octopus  
jar  
crab  
...trapped inside

hint at ...  
...be paired with ...  
fade away / out  
renewed  
embrace  
malleability  
regulate  
compensatory  
homeostatic  
hippocampus  
neocortex  
human subject research  
the vast majority of ...  
modality-specific  
ecological  
multisensory  
embody  
in one's infancy / infant  
stepping stone  
ad-hoc  
astonishing  
assimilate  
rehabilitate / rehabilitation center  
modulate  
overarching  
predominant / prominent  
profile  
grant  
seminal work / seminal fluid  
ocular  
newborn  
kitten  
deprivation  
...be characterized by ...  
...with the aim to ...  
comprise  
replicate / replica / replicant  
neuroscience

finding  
preferential  
transient  
amend  
be contingent on ...  
should / if  
usher  
interleaved  
in favor of ...  
graceful  
richness  
long-standing  
mitigate / alleviate  
...to make sense of ...  
be immersed in ...  
spatio-temporal  
make massive use of ...  
reservoir  
opt, opt to  
plastic / elastic  
embed / embedded  
intractable  
surrogate / surrogate mother  
mutable / mutation  
...in response to ...  
accommodate  
enforce  
vanilla  
resemble  
plausible  
habituate to .../ habituated  
these results reinforce that ...  
...be accounted for  
interplay  
episodic  
rehearsal  
cause-effect  
ambiguous

revise  
spontaneously  
a wealth of ...  
crossmodal  
schematic / schematic view  
valuable  
intricate  
dictate / be dictated by ...  
staged  
bootstrap  
tutor / tutoring  
unveil  
disclose, disclose the cause  
bilateral  
innate  
deceptive / deception  
scaffold  
exogenous / endogenous  
be congruent with / congruency / congruent triangle  
perceptual  
bind  
causal inference  
stationary  
disregard  
radically  
over the course of millions of years  
underpin  
evolutionary  
in-silico  
As a consequence = Consequently  
inspiration has originated more strongly from ...  
acronym  
genetic  
...take place as ...  
ambitious  
...derived from ...  
arguably  
set the stage for ...

a remarkable increase in ...  
dedicated  
...than in the past  
resonate with the readers / resonate  
touch upon  
in the remainder of ...  
with the intent / intention to ...  
make-up  
manifest / manifestation  
blueprint  
zygote  
nurture  
cultivate  
be now more aware of ...  
highlight the importance of ...  
deceive  
make no pretence of ...  
diversity and inclusion  
open-ended / open-endedness / open-ended questions  
pathway  
an alternative to ...  
empower  
synergy / synergy effect / in synergy  
statics / dynamics  
conducive / be conducive to ...  
reside  
delegate  
foster  
cope with ...  
genotype  
aspiration  
resurgence  
synopsis  
speculation  
pillar  
In essence = Essentially  
...in light of ...  
bloom

around 2019  
shift  
It's not after long that ...  
bet on ...  
masterfully  
expertise  
neat  
be indebted to sb. for sth.  
pickle  
customary / customarily  
brevity / clarity  
wit  
perturbation  
mastery  
neglect  
performant  
ingest  
comply with ...  
trademark  
aforementioned  
malformed  
blob  
glob  
a patient is admitted to the hospital  
administer drug  
concerned  
relative  
a sick thought  
not uniformly understood  
moderately  
be wrong in ...  
subjective belief  
a rational person  
conscious, make conscious use of ...  
inner-held  
...be judged to ...  
dwell (further) on ...  
philosophical issues



strike a balance  
outgrowth, an outgrowth of ...  
involvement in sth.  
attend a course  
span the entire spectrum  
Accordingly, ...  
In this spirit, ...  
sketch  
otherwise  
stand in the way of ...  
attentive  
conditioning  
omit / omission  
recitation  
elsewhere  
simplicity in exposition and sophistication in analytical reasoning  
a rich set of ...  
go into debt / be in debt  
acknowledge  
be thankful to ...  
Last but not least, ...  
take sth. (it) as a given (that ...)  
a short review about ...  
antiquity  
at the outset  
toss, a coin toss  
a die roll  
conceivable / conceivably  
excerpt  
in accordance with ...  
collective  
immediately obvious  
underlying  
Strictly speaking, ...  
pathological  
dart, throw a dart  
qualify  
constitute

successive  
identify  
namely  
downstream, ...downstream from ...  
For example; As another example  
Proceeding similarly, ...  
predede, preceding  
settle on ...  
by necessity  
counterpart  
...differ from ...in that ...  
spin  
...hinge on the fact that ...  
incidentally  
legitimate / legitimacy  
tractable / intractable  
Invariably though, ...  
inscribe / inscribed  
equilateral triangle  
millennium  
game of chance  
touch upon  
lay a / the foundation for ...  
raise the standard  
rigor / rigorous  
influential  
axiom / axiomatic  
pervasive / pervasively  
...in conjunction with ...  
traverse / traversal  
be inferior to ...  
a much discussed problem  
stick to / adhere to / insist on  
under this strategy  
celebrated  
...amount to ...  
malignant / benign tumor  
a common first thought

aircraft  
...state that ...  
In words, ...  
subsystem  
subinterval  
...consist in turn of ...  
populate, be populated with ...  
dial up  
modem  
the probability of interest  
facility  
facilitate  
combinatorics  
in principle  
thought  
a large portion of ...  
desired  
consecutive / contiguous  
cardinality  
algebraic identity  
instrument / instrumental, instrument readings  
two raised to the fifth power = two to the fifth  
a notion of  
associate with sth. sth.  
focus exclusively on ...  
qualifier  
a lot of new ground  
the general line of development  
genuine / genuinely, genuinely new  
give rise to a value  
In what follows, ...  
...in place of ...  
throughout  
conceptually straightforward  
range over ...  
By a similar argument, ...  
...is through ...  
characterize

be either for or against ...  
For all its simplicity, ...  
...be sketched in the section 3  
Note that here and elsewhere, ...  
the coin comes up a head with probability  $p$   
prior  
refer to ...as ...  
..., specialized to ...  
come up for the first time  
be monotonically decreasing with ...  
misspell  
typo  
...be well modeled with ...  
justification  
It is often desirable to ...  
monetary reward  
...in proportion to ...  
a weighted average of ...  
As motivation, ...  
anticipate  
roughly equal to ...  
dispersion  
pitfall  
It is not generally true that ...  
at a speed of ...  
...is obtained by nothing that ...  
prototype / prototypical  
attempt, attempt to  
coercible  
resist  
be evolving  
I'm still not done learning  
set up a structure for ...  
...as I see it  
elaborate upon ...  
groundwork  
one thing that initially surprised me was ...  
...come into play

There is no one right way to ...  
methodical / methodically  
linguistics  
field of study  
rhythm / melody  
keen  
modular mind  
vocal, vocal awareness  
chunk  
first-hand  
unconventional  
intonation  
stick  
clap  
consonance / dissonance  
palate  
most of the time  
muscle / muscular  
youngster  
stick out / stick way out  
dark is drawing in  
cavity  
nasal  
to name a few  
look up ...  
make sb. sure  
check out ...  
go over ...  
due to a difference of opinion  
homephone  
make a phone (call)  
repeat out loud / practice out loud  
drill ...  
you won't transform overnight  
dedicated, be dedicated to ...  
singleton  
bisect / bisection  
timezone

polaris  
anagram  
palindrome  
congestion  
pertain, pertain to ...= belong to ...  
universe  
In the same spirit, ...  
be destined to ...  
...argues in favor of ...  
regardless of ...  
flaw / flawed  
to some extent  
paradox / paradoxical  
scrutinize  
a great deal of information  
Roughly speaking, ...  
devil / devilish  
quirk / quirky  
testament  
a general agreement between intuition and what is mathematically correct  
...extends naturally to the case of ...  
imperative  
dialog  
weave / weaver, be woven into ...  
restraint  
budget  
Over the past three decades or so, ...  
purgeable  
bump  
synergy  
affordance  
induce  
worthwhile  
As machine learning is maturing, ...  
formalism  
toy / non-toy problem  
plague, be plagued by ...  
reinvention

induction / inductive  
speedometer  
insightful  
...be called for  
In any case, ...  
cf. = confer  
Graphically, ...  
gambler  
anticipate / anticipated  
for the time being  
light bulb  
burn out  
elapse  
meteorite  
Sahara desert  
..., be it through .../ Be it through ...  
staircase form  
line of argument  
a case in point  
in point of ...  
Loosely speaking, ...  
snowfall  
celebrate / celebration / celebrated  
conclude  
corrupt  
...parallel ...  
In complete analogy with ...  
vicinity  
needless to say = It goes without saying that ...  
needle  
mark the origin of ...  
a surface is ruled with lines  
line segment  
acute angle / obtuse angle  
midpoint  
justify  
the remaining time up to completion  
metro (train)

metropolitan  
board the train  
be analogous to .../ in analogy to .../ an analog of ...  
...carry over to the present context  
schematic  
It suffices to ...  
The converse of this statement is also true  
stencil / template  
chromosome  
bilingual  
in a row, 7 days in a row  
versatile / versatility  
variability  
interlinked  
in the vicinity  
but they still can't rival homo sapiens for complexity  
proposition  
be agnostic to ...  
they can be advantageously combined  
better off, better off alone / better off without ...  
nuisance, nuisance variable  
latent variable  
preclude  
resort to  
causality  
neat / neatly  
punctuation marks  
unleash  
I find them severely wanting in abilities  
arsenal  
divulge  
ideology  
triumph  
..., but that wasn't always the case  
proceed in chronological order  
hype  
extravagant  
publicity stunt



clip  
 cardinality  
 a means to an end  
 It's almost exclusively used for visualization  
 By itself this isn't very useful, but ...  
 genre  
 be akin to ...  
 induce  
 spark a great deal of interests  
 lately = recently  
 In the past this was all but impossible, ...  
 in complex learning regime  
 endorse / endorser / endorsement  
 amortize / amortization  
 resume membership  
 intra- / inner-  
 episode / episodic  
 hallucinate  
 assortative  
 resilience  
 discriminate between ...  
 confine, be confined to ...  
 a multitude of ...  
 ...outperform ...by a significant margin  
 ...be nigh  
 grace / graceful / gracefully  
 a gentle introduction  
 clarify the relationship between ...  
 myth = a commonly believed but false idea  
 cont. = continued  
 synthesis / synthesize  
 digest  
 compositionality = hierarchy  
 coefficient and intercept  
 mainstream models  
 an emerging line of work  
 cast ...as ...  
 In the same vein = In the same style of speaking or writing

attenuate = weaken  
 alleviate  
 meliorate its effects  
 rife, be rife in ...  
 discriminate specific tasks  
 conceived  
 mitigate, mitigate the risks  
 commonality  
 the unified definition of ...  
 backbone  
 acyclic graph  
 thesaurus  
 proactive  
 lockdown  
 oat  
 sportsmanship playing field therapy dialect stub negate / negation / negative  
 ...with the Bayes normalizer made explicit truly autonomous robot without  
 human supervision comply with ...blueprint from scratch hard-pressed com-  
 petence / competency sheer, sheer size There's no point doing sth appreciate,  
 appreciate that it's difficult to ...at stake, This example gives a good flavor of  
 the problem at stake the main utility of ...audit scaffold front-matter excerpt  
 amend favicon verbatim reclaimable delineate ordinate booklet coordinator  
 installing manifest presumably ethnicity pathetic malicious heartbreaking be  
 singled out victim merit pandemic furious people are in high spirits circu-  
 lation racial discrimination paranoid precaution blast out rule people with  
 iron fist agenda protest set the title of the video as a clickbait skyscraper  
 footage invocation well-gearred, they're geared towards different things grace-  
 fully puddle Very likely there are errors hue be endowed with ...in the same  
 vein It is primarily used for ...the function under consideration recast axiom-  
 atize inscribe a hilly terrain It can be loosely thought of as ...Likewise .....as  
 thought they are ...methods that are specially tuned for ...spur, It was their  
 use that spurred the development of ...fallacy gambler judicious ...in question  
 = ...being discussed preconditioner filtration The distinction consists in the  
 change of the majority of real operations by the corresponding complex opera-  
 tions deviation unconditionally They are hardly ever used viz secant damped  
 method stuck at ...denominator / numerator flutter As regards ...risk to do sth.  
 certify ...predates ...by 3000 years wiggle circumvent, the problem is circum-  
 vented with the twofold aim of ...the problems fall into two categories conic

intervention designate extraneous confound concave / convex These differences must be considered whenever the solution to a nonlinear least squares problem is being sought intercept a fully worked out example fluctuation To the right is a plot illustrating ...parabolic / parabola / paraboloid rearrange / rearrangement It's cost-prohibitive and time-consuming veterinary census circumflex qualifier bull's eye grossly clustered / dispersed preclude idempotent reciprocal concentric elliptical expedient extremum / extrema attain stipulation keep ...from being too short stringent restrain Varying these will ...adhere rationale the model is in good agreement with the data regularity the cut-off value This algorithm interpolates between A algorithm and B algorithm uninformed gratification contract, the region is contracted operationalize, It operationalizes "too far" as follows monotonic pathological evident without the agonizing pain be regarded as ...computational burden ...thereof enormous de facto anticipate pedestrain legacy style It is preceded by ...versatile primitive ...at the forefront of 5G technology be way ahead of ...The USA is quite a distance behind China on 5G technology canal waterway fairytale, arriving here is to step into a fairytale cape inhabitant afterlife blossom, the cherry blossoms peaceful We were somehow talking without speaking the same language backdrop alleyway inn hostel breathtaking We have no clue what's going on like why ...authentic Unfortunately, the weather was not cooperating acrobat show Terracotta warriors the research base of giant panda breeding They work up the nerve the say hello selfie, These girls are keep snapping the secret selfies with us performant asteroid It is rarely the case that one starts with the exact and complete formulation of the problem that one is trying to solve To this end we ...ship with ...time and memory budget routine It is used for benchmarking the least squares solvers at scale irrespective of ...crucially, crucially important refer to ...as ...a trivial problem grant ...I have no idea at this point This answer is on the mark qualifier invoke / invoker / invocation synopsis prevent heaps and stack overflows from overwriting it hassle a good start to ...a cure-all otherwise = except for what has just been referred to Lots of memory leaks could just be carelessness in an otherwise well designed program, but more likely you have significant design issues and the memory leaks are a symptom of that If by "smart pointer" you mean "a pointer and a reference counter" then not all structures are amenable to smart pointers imperative sentence Finally, both classical methods are slow at computing partial derivatives of a function with respect to many inputs, as is needed for gradient-based optimization algorithm a specific manifestation of ...Fundamental to AD is the decomposition

of differentials take ownership of ...lest dangle verbatim tentative mutually exclusive polymorphism mandatory dictate, be dictated by ...oblivious digest perturb / perturbation be specialized to ...restore facility, It offers the same facilities of ...a problem instance to this end provide means to .....uses respectively ...and ...enlighten / enlightening intrusive, this approach is too intrusive insist disastrous overleaf unilateral / unilaterally inadvertently relinquish incentive disambiguate nominate temptation cast away ...glitch, I'd upvote this except for one glitch that ...lexical / lexically on a per file basis mutable / immutatable bookkeeping detach designate photogrammetry / photogrammetric The theory is developed for general robust cost functions rather than restricting attention to traditional nonlinear least squares. geodesy reinvent synthesis forestall misconception quantify a matter of ...screen / screening, outlier screening integrally opaque fixed quantities reciprocal diminish / diminishing elasticity unduly It fits well with ...They are capable of choosing ...themselves Classically, ...the claimed ...the unthinking use of ...presumably, ..., presumably meant to ...be resistant to ...afterwards, ...and results (should be) checked afterwards to verify their reliability It is too seldom appreciated extraordinary mask gross errors profusion, a profusion of ...There's a tendency in ...exotic articulate / articulated, dynamic or articulated models a sound methodology economical methods As the technique matures, .....predominates over .....the same way as it ...an inevitable consequence a great appreciation of ...a rapid sketch of ...touch on ...provision / provisional, provisional recommendations cultural differences It is now quite dated viewpoint superlative plenty, plenty of .../ plentiful take sth in (one's) stride far more complicated models oblique aberration pinhole camera slide along the line complication be subject to ...unwanted homeomorphic These arise because ...delicate compound they are in principle equivalent profound / profoundly hinder excessive As examples we consider 3D points and rotations intrinsic / intrinsically comb glue / gluing doughnut pliable dimple squish stroke supposedly strip contract / contractible torus postulate interior / exterior jargon They are same up to ...immerse sphere crab ...so long as ...immediate wander bizarre inescapable, inescapable consequence grasp, grasp the idea / grasp the difference disastrous apart from ...trim, data trimming argue this at some length it is poorly understood whim, personal whim wholly, it is wholly a matter of ...the ...of choice disparate They are independent of one another intuitive appeal Many of the most notable ones are ....., so as ...coincide with ...It can be used in place of ...peculiar / peculiarity indifference blunder the whole basis of ...irreducible henceforth more or less footing, be on

an equal footing isotropy warp / warping nuisance owing to ..., owing to the  
 fact that ...exceptionally accolade by no means ..., It is by no means trivial  
 non-negligible armpit bump forefinger keystone inflection point stall over-  
 shoot assure cartography site-modelling occasionally scaling makes itself felt  
 indirectly in several ways judicious subdivide, be subdivided into ...primary /  
 secondary subdivision worthwhile dissection detach lay the foundation of ...In  
 rough terms, ....., in much the same way that ...manifest file profound pro-  
 totypical inconclusive a recipe for ...defective utmost, utmost importance a  
 broad introduction predecessor / successor be inversely proportional to ...in  
 lieu of ...salient, salient features instant, time instant centroid devastating  
 delicate blob artifact attain compensate quadrant rectify undergo cue con-  
 taminate blur bilateral exemplar there is a high interest in using ...endeavor,  
 in the endeavor of ...a compound of ...miniaturization endow ...with ...amount  
 to ...prescrib be predicated on / upon ...mutilation corpus rigorous resort to  
 ..., By resorting to ...celebrated ample relegate profound initiative, We have  
 for this taken some initiatives with regard to ...opt to ...undertake, be under-  
 taken with ...beacon spike be akin to ...alike crease insofar genus superposition  
 authentic knob pendulum reconcile detour compact / paracompact sneaky  
 denumerable stereographic projection instantaneous detour polyhedron com-  
 patible kinship orbit shed light on ...elucidate profanity Dihedral congruence  
 thrill exposition retraction numerator / denominator agglutinate improbable  
 compendium punctual axial velocity longitudinal velocity / lateral velocity  
 wireframe to this end = for this reason thrice snack / street food minute,  
 minute particles mnemonics antipodal = diametrically opposite deem, We  
 deem it trivial in the sense that ...radical contrast, In radical contrast stitch  
 / stitching treatise rudiment youngster figurative, In a broad figurative sense  
 give rise to portray diffraction / refraction / reflection deflect substance ra-  
 diate anatomy holy grail iris / pupil eyepiece diaphragm aesthetic rectilinear  
 spectacular opaque blade allude alternations in ...necessitate, changing one  
 setting will necessitate a change in the others In the meantime territory film,  
 film camera vital meticulous / meticulous designing and testing front / rear  
 gyroscope counteract / compensate photon radiant flux Vaguely speaking  
 Why on earth ...solid angle a class of .../ a family of ...radial direction so-  
 phisticated aberration flush permissive pincushion mustache at your disposal  
 postpone brittle / brittleness bloat dispute nonetheless trait compliant spot,  
 It can be spotted anywhere inadvertently reconcile at the outset discern van-  
 tage point envision differentiate in our notation an image point  $x$  from its  
 homogeneous representation opaque admittedly we cannot count on equation

(4.4) being satisfied at all crude / coarse approximation lump all sources of ...into ...This separation is more conceptual than factual What appears as smooth shading on a small patch in a high-resolution image may appear as a sharp discontinuity on a large patch in a subsampled image. serenity violet What particular motion (R,T) and 3-D structure X must the scene undergo to satisfy this model? coherent raster / rasterize palette notorious parallax oversight montage deliberately warp, warped image reluctance readily innocuous conceal confront, The ultimate task confronting us in the uncalibrated case is ...tentative

## 11 slam

make it free of noise  
prolific  
propeller  
proximity  
sloppy  
rail  
it deviated from its path  
diameter  
get drift to one side  
by-product  
azimuth  
lawn mower  
compromise  
surveillance  
reef  
reefer  
archaeology / archaeologist  
ceiling  
infrared  
showcase  
conduct the project  
proximity, proximity sensor  
joystick  
revolution, revolution of the wheels  
...same holds for ...

sketch, a sketch of ...  
successive iterative process  
it happens from time to time  
...prevail in the domain of ...  
volumetric representation  
there is no way around ...  
geodesy  
acronym  
coin / coined  
...thus far  
comprise  
in-depth  
thoroughly  
central topic  
exclusively  
exogenous  
amenable, be amenable to ...  
exposition  
contemporary  
...is by no means to be ...  
Rather, ...  
descriptive  
not infeasible  
Such extensions, ...  
characterize ...  
appear, may appear to ...  
provision  
in the first place  
vastly  
overestimate  
accommodate certain tasks  
postulate  
whereabout, the whereabouts of people  
accrue ...  
...as indicated  
This chapter provides in detail ...  
projectile  
...concerned with ...

a comprehensive introduction into / to ...  
subfield  
monograph  
overarching  
temporal / spatial extension  
commonality  
discourse  
insofar, insofar as ...= to the degree that ...  
wordy  
laborious  
at times  
...emerge with ...  
superficial  
exposition  
planetary  
be in one's infancy  
in the proximity of ...  
First and foremost, ...  
perturb / perturbation  
heavy-duty  
wear-and-tear  
flaky  
rather crude  
realm  
stumble / stumbling  
pay tributes to ...  
Put differently, ...  
ambiguity  
degree of belief  
in the face of ...  
graceful / gracefully  
pertain, ...pertaining to ...  
distinguishable / indistinguishable  
plausible  
by no means does ...  
momentary  
err  
deprive



paramount  
coastal  
anticipate / anticipation  
cut across  
reactive / proactive  
relieve  
insurmountable  
sole  
sound  
...come at a price  
weak link  
unprecedented  
bargain, at bargain prices  
branch into / out  
self-explanatory  
pitfall  
set forth, ...set forth below  
virtually  
familiarize ...  
predominant / predominantly  
brevity, ...lies in its brevity  
coincide / coincidence  
a final concept of importance  
stray  
..., so as to ...  
revolute joint  
...entails that ...  
...be mediated by ...  
single out ...  
for didactic reasons  
tactile, tactile sense  
query  
Hypothetically (speaking), ...  
in accordance with ...  
in the material yet to come  
stochastic / stochasticity  
time step  
...will be explored pervasively

...as to ...  
...is that of ...  
reflect  
synonym  
elucidate  
by virtue of ...  
know ...with certainty  
be entirely ignorant about ...  
restrict ourselves to finite situation  
postulate  
violate / violation, induce violations of the assumption  
as a (general) rule of thumb  
ramification, have important ramification on ...  
with no unique best answer for all ...  
a wide array of ...  
attain  
by induction  
predate  
easy / involved  
scent / scented / unscented  
immense / immensely  
treatment  
provision  
be amenable to ...  
it is descriptive of the state of the art  
preliminary  
accrue  
pendulum  
steer, steering wheel  
articulate / articulated  
limb  
hexagon  
clockwise / counterclockwise  
It accepts as inputs ...  
hypothesize / hypothesized  
moderate  
it suffices to ...  
perturb

handy  
...amounts to ...  
retro-, retrospect  
formula / formulae  
in lieu of ...  
erroneous  
slippage  
This poses no problem for ...  
side-step  
in action  
superimpose / superpose  
...pertaining to ...  
call for ...  
keep ...into account  
upon executing ...  
factorize ...into  
be subsumed into ...  
.... One then ...  
traverse / traversal / traversable  
significant overhead  
importance factor  
Care has to be taken in ...  
...leading up to ...  
discard the information  
shed light on / onto ...  
As far as ...  
sideward  
estate, real estate  
disguise, in disguise  
tactile sensors  
fire a signal towards ...  
reflective surface  
predictable  
be paraphrase as ...  
specular reflection  
problematic  
the likelihood of this to happen  
coal mine

caveat  
herein, Herein lies a key advantage of ...  
hereinafter  
crude  
saturation  
recapitulate / recapitulation  
drop the distinction between ...and ...  
adopt  
be among the most popular / important ...in ...  
range finder  
phantom, phantom readings  
eyeball  
susceptible, be susceptible to ...  
a plain implementation  
the main drain of ...  
run the danger of ...  
ad hoc  
pre-compute  
advantageous  
diminish  
myriad, a myriad of ...  
devise  
indeterminacy  
spiral  
ring  
introspection  
with the advent of ...  
alleged  
by virtue of the fact that ...  
inferior / superior  
inflate  
enabling technologies  
in the pursuit of ...  
deceptive / deceptively, deceptively simple / easy  
While ..., despite ...  
at present  
be largely credited for / to ...  
strive hard for / to

As we strive to ...  
centerpiece  
layman, a layman introduction to ...  
roam  
be endowed with ...  
door post  
fallen out of fashion  
easy to reason about  
speculate / speculation  
a flurry of ...  
intimate, intimate relationship / contact  
be intimately related to ...  
vanilla, a vanilla ...  
in the very beginning of ...  
persist, ...persists over time  
provisional  
novice, be novice in ...  
in the light of ...  
monolithic  
trunk, tree trunk  
overlay / overlaid, ...overlaid on ...  
depletion  
an educated guess  
elapse / elapsed, time elapsed  
in the spirit of ...  
oracle  
be suspected to ...  
hurdle  
hinder  
hamper  
sidestep  
a close-up view of ...  
considerable  
be anticipated to ...  
a wealth of information  
fire hydrant  
visual imagery  
commodity

be in line with ...  
histogram  
ramp  
quadrant  
trigonometry  
that's the case  
judge by yourself / judge on yourself  
time to wrap up  
file an issue  
run into issues / problems  
tray  
whale  
synopsis  
seasoned  
dialect  
directive  
dictation  
comply with ...  
cutting-edge  
what appears to be computationally easy in one parameterization is involved  
in the other, and vice versa.  
...stems from ...  
alternate ...with ...  
up front  
subsume  
curvature  
render ...inapplicable to all but the most trivial problems  
distort / distortion  
resort to ...  
incur  
a logical choice  
...deemed ...  
contender  
cooperation and division of labour  
It's difficult in that ...  
bring ...to bear on / upon ...  
...has to do with ...  
at times

be in stark contrast to ...  
In a nutshell, ...  
artificial beacons  
intolerable  
ceiling  
kidnap / kidnapped / kidnapper  
One might argue that ...  
other than ...  
Of particular interest are ...that ..., and that ...  
accommodate noise / dynamics  
through some other means  
hazard / hazardous  
impasse, recognize the impasse and escape from it  
the hardness of the problem  
coincide with ...  
hallway  
be flattened out  
brittle  
the most simple at all is ...  
take ...for granted  
thoughtful  
reconcile  
asymptotic / asymptotically  
with relative ease  
deposit  
cliff  
distant  
tentative  
situate, ...situated in ...  
provision / provisional  
shrink / shrunk / shrinkage  
reduce ...by a significant factor  
in the face of ...  
lean  
...deviates from ...  
reduce ...to ...  
It is therefore common practice to ...  
Little is currently known about ...

distinctiveness

scarce

culminate in / into ...

The advantages of ...are manifold: ...

predate, ...predates ...by many centuries

picture a situation where ...

proactive

selectively gist wraparound exploit for the sake of ...exposition fabricate / fabricated mandate be at odds with ...decentrally overhead, necessary overhead comparable facility for ...ethics / moral rod revenue, revenue figures obtainable inquiry ...as is we don't know ahead of time ...in a related, but slightly simpler, way to ...couch, couch ...in / as ...embody moderately, moderately large In retrospect, ...take as input ...save in the location ...a collapsed version coalesce be proportional to ...for clarity and conciseness discrepancy a short wrap-up a spectrum of ...proactive checkerboard practically, it's practically zero ..., where disks correspond to point features and dashed arcs to links logarithmic employ a technique / step circumvent extra conjecture take ...with a grain of salt rudimentary allusion cafeteria ...formerly at the head of the queue get rid of ...smear it's mathematically more sound random clutter the gold standard of ...fine-grained the number of ...are in the tens of thousands ..., namely ...decipher counterintuitive by virtue of ...the cell is free outweighed that of it being occupied have a hard time doing sth black correspond to ..., and white to ...make decisions exclusively based on ...disparity it's not an easy endeavor poll vignette at sb's disposal affirmative sink in some instances exhibit excellent performance in ...fielded systems a naive implementation if not properly treated prevent the system from working ..., arguably the most popular ...to date turn our attention to ...narrow spikes unassailable henceforth, ...which henceforth will be called ...under mild conditions be unaware of the state repetitive daunting manifest the advantage is threefold culprit less pronounced deprivation wipe out last resort versatile lay the groundwork for ...throughout the remainder of the book However, this shall not deter us here Admittedly, ...low-end / high-end the ambiguity is resolved ...of practical importance It is not bound to a limited ...trade off ...and ...As our illustrative results suggest, ...blend ...seamlessly with ...paramount spread over a large volume a rather simple ...add an additional level of robustness If we were to ...This is even true for ...discuss in length Luckily, a simple trick provides remedy, ...Without delving into too much detail, ...depletion In a nutshell Whereas ..., ...be implemented in time logarithmic in the number of



features descendant barring ...investigate it in more detail first principles be largely equivalent to ...On the surface, the difference looks rather marginal The reader may recall that ...This is problematic when ...a large spectrum of ...the mathematical derivation is more involved two orders of magnitude savings a sequence of ...of growing size decent, a decent job misalignment lecture hall grit workaround there's no black magic around that null points successive in a nutshell malicious be known a priori detrimental, be detrimental to ...You'll be a master by the time you're at my age one instance of this approach envision hopefully it helps more than hinders cluttered / clutter slippage / slip on the fly criterion / criteria equirectangular It is not without limitations when compared with ...One was already discussed: .....shows no such time dependence be superior in accuracy to ...elucidate, This difference will be elucidated below, where ...The basic intuition behind ...is remarkably simple pay tribute to ...induce a constraint It is linear in the time elapsed equally Attention has to be payed to .....culminate into ...book-keeping be composed of ...square matrix / quadratic matrix Subsequently, ...outline, The algorithm is outlined in Table 1 The quality of ...depends on the goodness of initial estimates derive from them the ...infinitesimal For now, it shall not concern us that ....., with a few differences pertaining to .....highlights an essential characteristic of ...alleviate the problem by ...The interested readers shall be referred to the bibliographical remarks for more pointers to ...manifest itself by ...keep the computation low the techniques yield favorable results bipartite postpone ...has emerged from a number of different scientific fields a number of follow-up papers subterranean Following observations in ...SLAM is a highly active field of reasearch a more detailed elaborate model artificial beacons pave the way from ...to ...seminal, seminal papers / seminal algorithms It parallels work by ....., albeit ...occasional from time 1 all the way to time  $t$  by virtue of ...issue command provision pay tribute to ...To efficiently solve many tasks envisioned to be carried out by mobile robots, ...parking garage a bird's eye view of the area with the sole use of its on-board sensors the advancement in the field of ...the synthesis of the method The transition model  $p(x_t | x_{t-1}, u_t)$  is represented by the two edges leading to  $x_t$  and represents the probability that the robot at time  $t$  is in  $x_t$  given that at time  $t - 1$  it was in  $x_t$  and it acquired an odometry measurement  $u_t$ . exteroceptive An alternative representation to ...is .....consists in ...sensor dependent / sensor agnostic system integration It has many applications ranging from ...to ...interleave ...and ...Let ...and ...be respectively the ...and .....originates from ...Whereas ..., ...We first .... Subsequently, we ...workaround, a workaround

that allow us to deal with ...An efficient yet compact implementation of the algorithm by definition / by construction between consecutive time frames a variant of ...reenter perturbation accordingly However, not appropriately considering the singularities leads to a divergence

## 12 Introduction to Algorithms

fertile at your /our disposal well / wells crew surmise present quite a challenge sketch out ...tantalize / tantalizing all the more be intrigued by / with ...fruitless / fruitlessness depot readily count on ...roadblock ever-increasing liken ...to ...elicit once craftiest programmer at the core of ...prominent Having ..., we then ...end (up) with ...at all times pile, a pile of ...get bogged down in ...wording short circuiting inferior algorithms abuse endeavor, endeavor to ...dexterity suppress, suppress tedious details ...that really interests us motif stop once ...bend, a tight bend an additional twist values that have yet to be copied values that will be copied over bottom up, bottom-up approach top down, top-down approach ...progresses from bottom to up division of the problem we reason as follow we have that ...an argument justifies this claim among other factors hyphen typeset in small caps interdependent After the line containing procedure name come one or more lines of code flush, flush the toilet / flush left in the eyes of ...For the most part, ...Mindful of request of our readers to ..., we ...ladder line up ...Upon seeing ...trail-and-error approach the references will resolve to the line numbers On rare occasions, ...out of order check ...against ...the initial call to either version the only way in which ...a one-to-one correspondence between ...and ...the other way around be tailored to ...negligible an exhaustive search In so doing, .....: a contradiction. hallmark a simple inspection in spite of the two key ingredients that an optimization problem must have discuss more fully ...characterize ...contains within in ...supposition give rise to ...unless, Unless we could guarantee that ..., we would ...we first ...and, having ..., ...in a ...fashion informed, an informed choice / opinion ...as well be tempted to ...splice the index / vertex at which we ...excise ...in the sense that ...contradictory in greater detail examine a problem ..., as does ...inspection, inspection of the procedure yields ...as a practical matter as a matter of fact ...saves us a significant amount of work ...fill in the table ...has yet to be filled in Each subsequent time that we encounter this problem, we ...upon ..., That depends on / upon the circumstances Note where it resembles ...organism a strand of .../ a string of ...To

be precise, ...eliminate the table altogether ...so as to ...a search will be for  
it caption, the caption of the figure nor can we necessarily ...an exhaustive  
search contiguous, a contiguous range ...has as its leaves ...There is one detail  
worth nothing about ...Bear in mind, ...For the base case, ...its for loops are  
nested three deep take on at most  $n$  values complacency