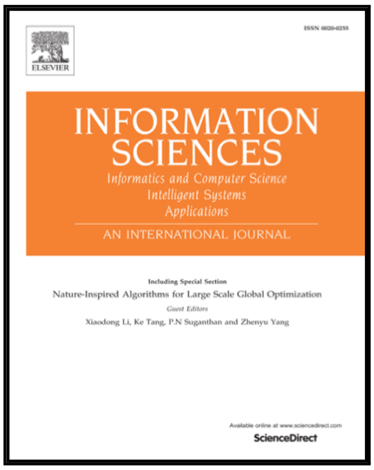
Accepted Manuscript



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Jin-He Wang, Fan-Yun Meng, Li-Ping Pang, Xing-Hua Hao

PII: S0020-0255(17)30614-X
DOI: 10.1016/j.ins.2017.03.023
Reference: INS 12806

To appear in: *Information Sciences*

Received date: 21 July 2016
Revised date: 2 January 2017
Accepted date: 21 March 2017

Please cite this article as: Jin-He Wang, Fan-Yun Meng, Li-Ping Pang, Xing-Hua Hao, An Adaptive Fixed-Point Proximity Algorithm for Solving Total Variation Denoising Models, *Information Sciences* (2017), doi: 10.1016/j.ins.2017.03.023

An Adaptive Fixed-Point Proximity Algorithm for Solving Total Variation Denoising Models *

Jin-He Wang[a b], Fan-Yun Meng[b †], Li-Ping Pang[c], Xing-Hua Hao[c]

[a] *School of Engineering, Huzhou University, Huzhou 313000, China.*

[b] *Computer Engineering Institute, Qingdao Technological University, Qingdao 266033, China.*

[c] *School of Mathematical Sciences, Dalian University of Technology, Dalian 116024, China.*

Abstract We study an adaptive fixed-point proximity algorithm to solve the total variation denoising model. The objective function is a sum of two convex functions and one of them is composed by an affine transformation, which is usually a regularization term. By decoupling and splitting, the problem is changed into two subproblems. Due to the nonsmooth and nondifferentiability of the subproblem, we solve its proximity minimization problem instead of the original one. To overcome the "staircase" effect during the process of denoising, an adaptive criterion on proximity parameters is put forward. At last we apply the improved algorithm to solve the isotropic total variation denoising model. The numerical results are given to illustrate the efficiency of the algorithm.

Keywords ROF total variation, fixed-point algorithm, split Bregaman, image denoising.

2000 MR Subject Classification 65T60, 90C25, 68U10.

1. Introduction

We consider a class of unconstrained optimization problem having the form:

$$\begin{array}{ll} \min & \Phi(x) + \Psi(Bx) \\ \text{s. t.} & x \in \mathbb{R}^n, \end{array} \tag{1.1}$$

where $\Phi : \mathbb{R}^n \to \overline{\mathbb{R}}$, $\Psi : \mathbb{R}^m \to \overline{\mathbb{R}}$ are proper l.s.c convex functions, B is a matrix of $m \times n$ dimensions and $\overline{\mathbb{R}} := \mathbb{R} \bigcup +\infty$. The model (1.1) includes a wide variety of optimization problems generated from image and signal processing. A familiar example is the Rudin-Osher-Fatemi (ROF) total variation model in image denoising [29] and other examples are high-resolution image reconstruction [6], [32], [33], total variation based on impulsive noise removel model [22] and multiresolution sparse regularized model [11].

The difficulty to solve (1.1) is the nondifferentiability of the objective function. For example, the classic ROF total variation model [30] is to minimize the sum of a ℓ_2 (ℓ_1) norm and a total variation (TV) regularization, which is nondifferentiable. There are great challenges to solve such

*The research is partially supported by Huzhou science and technology plan on No.2016GY03, the Natural Science Foundation of China, Grant 11501074 and 31271077.

†Corresponding author. Email: mengfanyundlut@163.com