Proposals for data analysis activities in KAGRA

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(NIMS)

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Research Unit Proposal Form

- **Unit leader** (Full name, current position, email address)
  - Full name : OH Sanghoon (OH is family name)
  - Current position : Senior Research Scientist (NIMS)
  - Email address : shoh@nims.re.kr (oh.sanghoon@gmail.com, backup email)

- **Affiliation of unit leader**:
  - Institute : National Institute for Mathematical Sciences (NIMS)
  - Address : 70, Yuseong-daero 1689-beongil, Yuseong-gu, Daejeon, 34047, South Korea

- **Members** (Full Name, current position, email address, roles)
  (please specify the roles of each member)
  - Full name : OH John J. (OH is family name)
  - Current position : Senior Research Scientist (NIMS)
  - Email : johnoh@nims.re.kr
  - Roles : Deep learning algorithm based Data Analysis

  - Full name : SON Edwin J. (SON is family name)
  - Current position : Senior Research Scientist (NIMS)
  - Email : eddy@nims.re.kr
  - Roles : Deep learning algorithm based Data Analysis

Research Unit Proposal Form

- **Members** (Full Name, current position, email address, roles)
  (please specify the roles of each member)
  - Full name : KIM Whansun (KIM is family name)
  - Current position: Research Scientist (NIMS)
  - Email : iou78@nims.re.kr
  - Roles : Deep learning algorithm based Data Analysis

  - Full name : BAE Yeong-Bok (BAE is family name)
  - Current position : Postdoctoral Researcher (NIMS)
  - Email : baeyb@nims.re.kr
  - Roles : Deep learning algorithm based Data Analysis

Research Unit Proposal Form(cont'd)

- **Working groups**
  (Choose from CBC, Burst, CW, Stochastic, EM follow-up, Software and computing, MLA):
  - CBC
  - MLA

- **Research plan:**

1. Working group : CBC, Project: Deep Learning based CBC Search Pipeline & Astronomy
Description of research : NIMS group members are focusing on the machine learning based signal search algorithm for CBC sources. It is based on the matched filter method basically but various alternate way of finding new approaches are explored. Improving background estimation by using Deep learning is also included.

Members : Sanghoon OH, Edwin J. SON, John J. OH, Whansun KIM, Yeong-Bok BAE
Collaborators : Hyung Won Lee (Inje Univ.) Yusuke Itoh (Osaka City Univ.), Tjonnie Li (CUHK), Kazuhiro Hayama (Fukuoka U.), Hirotaka Takahashi (Nagaoka U. of Tech.), Takahiro Yamamoto, Takaaki Yokozawa (ICRR), Yuan-Chang Hann (NCU), Ting Wai Chiu (NTU), Sadakazu Haino (Academia Sinica), Yuki Inoue (Academia Sinica), Albert Kong (NTHU), Feng-Li Lin (NTNU), Chun Yu Lin (NCHC), Guo Qing Liu (Tamkang U.).

Proposal for DA by KGWG-NIMS

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Title: Deep Learning based CBC Search Pipeline & Astronomy

Research Items :

1. **Deep Learning based CBC/GRB search using auxiliary channel information**
   Enlarge feature spaces with CBC/GRB features by adding more informations provided by auxiliary channels -- may improve classification performances / detection statistics, hopefully.
2. **Variational Inference based Parameter Estimation**
   One of deep algorithms, called variational inference, can search the physical parameters of CBC pipelines, in a different way with Bayesian inference. We investigate the feasibility of the application.
3. **Generating GW waveforms using Generative Adversarial Network (GAN)**
   MR phase waveforms are so expensive for computations because of full GR simulation. So it is meaningful to generate the waveforms with relatively cheap computational costs using generative algorithms. Now we are investigating its feasibility using GAN and its mutant algorithms such as wGAN, infoGAN, and so on .