

**Topic-Setting Program to Advance Cutting-Edge
Humanities and Social Sciences Research**
(Global Initiatives)

Progress Report
(Summary of Final Report)

[Private international law in the AI era]

Core-Researcher: Ken Satoh

Institution: National Institute of Informatics

Academic Unit: Principles of Informatics Research Division

Position: Professor

Research Period: FY2019 – FY2021

1. Basic information of research project

Research Area	Developing new genres of humanities and social sciences that address head-on technological innovation such as rapid IT and AI advances and environmental issues
Project Title	Private international law in the AI era
Institution	National Institute of Informatics
Core-Researcher (Name, Academic Unit & Position)	Ken Satoh, Principles of Informatics Research Division, Professor
Project Period	FY2019 – FY2021
Appropriations Plan (¥)	FY2019 5,200,000 JPY
	FY2020 10,400,000 JPY
	FY2021 10,400,000 JPY

2. Purpose of research

Nowadays, AI systems themselves rather than humans, exchange data and conduct commerce across countries such as the cloud computing, smart contracts, and blockchains. Therefore, in order to legally control such international data distribution and international transactions accurately and efficiently, it is necessary to modernize private international laws such as international transaction law. The purpose of this research is to implement such an elaborate formulation in international collaboration between artificial intelligence researchers and private international law scholars, and to implement a prototype that can be incorporated into AI based on it and to consider how private law in AI era should be. This research will give Japan a leading position in modern private international law.

3. Outline of research (Including study member)

Study Member

Research Role	Name	Institution / Academic Unit / Position
Core Researcher	Ken Satoh	National Institute of Informatics/ Principles of Informatics Research Division/Professor
Co-investigator	Souichiro Kozuka	Gakushuin University/Faculty of Law/Professor
Co-investigator	Yuko Nishitani	Kyoto University/Faculty of Law・Graduate School of Law/Professor
Collaborator	Shozo Ota	Meiji University/Faculty of Law/Professor
Collaborator	Takahiro Sawasaki	National Institute of Informatics/ Principles of Informatics Research Division/PostDoc Researcher
International Collaborator	Laura Girodano	Università del Piemonte Orientale/Istituto di Informatica/Professor
International Collaborator	Matteo Baldoni	Università degli Studi di Torino/Dipartimento di Informatica・Dipartimento di Giurisprudenza/Professor
International	Giovanni Sartor	Università di Bologna/Dipartimento di Scienze

Collaborator		Giuridiche/Professor
International Collaborator	Dan Svantesson	Bond University (Australia) /Department of Law/Professor

We set the following three research topics as follows.

**(1) Identifying issues related to legal reasoning about international affairs,
especially on deciding choice of law:**

In private international law, the determination of the applicable law by “choice of law” rules is one of the fundamental and crucial problems. Thus, we firstly will work on a logical formalization of “choice of law” rules in order to constitute a basic theory for managing “choice of law” issues. In Japan, we have a statute named “Act on General Rules for Application of Laws” (AGRAL), which gives a solution concerning the applicable law to some kinds of international legal relationships, but it does not cover all kinds of questions surrounding “choice of law”. Another problem would be that some abstract term like “implicit agreement on choice of law by the parties” is used in interpreting the AGRAL, which is difficult to formalize. Thus, we will consider problems related with these uncovered issues and the treatment of such abstract terms.

(2) Examination and evaluation of solutions to problems related to “choice of law” :

In the next step, we need to solve the problems identified in (1) and once we have got a solution, we need to evaluate it. We firstly analyze these problems and legal scholars (Kozuka, Nishitani and Ota) will try to find solutions to this problem. Based on their results, AI researcher (Satoh) will translate it into a logical form. For a logical form for a formalism of “choice of law”, we firstly consider using “modular logic programming” developed by Giordano and Baldoni, where each module represents rules in each country.

(3) Formalizing and Implementing “choice of law” in PROLEG:

We translate modular logic programming into PROLEG, a legal knowledge representation logic programming language which Satoh has been developing since 2009. It is because Satoh has an implementation of PROLEG so we can automate a process of choice of law by PROLEG system.

A program of PROLEG consists of a *rulebase* and a *factbase*.

A rulebase consists of

a set of rules of the form

$H \Leftarrow B_1, \dots, B_n.$

where H (called *head*) and B_1, \dots, B_n (called *body*) are first-order atom,

and a set of exceptions of the form $\text{Exception}(H, E).$

where H and E are the head of some rules.

A factbase consists of set of the following expression $\text{fact}(P).$

where P is an atom in the body of some rule.

A rule represents a general default rule, meaning that if all the condition of the rules are proved then in general, H is true except there are is an exception E in $\text{exception}(H, E)$ such that E is proved.

We would like to represent “choice of law” in PROLEG as the final target, since it is more understandable for lawyers. Firstly, we translate a formalization of “choice of

law” in modular logic programming into the most frequent used logic programming language called PROLOG and then we translate it into PROLEG.

4. Research results and outcomes produced

(1) Identifying issues related to legal reasoning about international affairs, especially on deciding choice of law:

Firstly, we investigated the way of functioning the “choice of law” rules as identified in the current practice of private international law and examined to what extent it can be automated. The process of determining “choice of law” includes classifying cross-border cases into a single unit of legal relationship as defined in the AGRAL, the characterization of each unit of legal relationship, the determination of the connection factor, and the determination of the applicable law based on the connection factor. We confirmed that all these steps can be automated. At the same time, we also investigated some problems related to the determination of the applicable law, such as the parties’ choice of law for contracts in court proceedings and arbitration proceedings, especially the extent and functioning of the parties’ freedom of choice of choice of law, theories of its limitations, and the criteria for judging the parties’ explicit and implicit intent.

(2) Examination and evaluation of solutions to problems related to “choice of law” :

Satoh modularized the general and local laws of each country, formulated the renvoi which delegates an international case to the law of another country as communication between modules, and apply the law of the country where the renvoi stopped or the country where the loop originated as the choice of law. The idea was presented at JURIX 2019, European Conference on AI and Law (co-authored with Laura Giordano and Matteo Baldoni). Also during JURIX 2019, Satoh discussed the logical formulation of private international law with Giovanni Sartor and received useful advices.

We also compared our solution with other solutions such as difference between the formalization in a book, titled “Ultimate Fact Theory for Private International Law” , by Tadashi Oe (DaiichiHoki, in Japanese).

(3) Formalizing “choice of law” in PROLEG:

Before formalizing “choice of law” in PROLEG, we translated a formalization in modular logic programming into ordinary logic programming language, PROLOG. It is because direct translation seems to lead to complications. We verified the behavior of the formalization in PROLOG and presented a paper at JURIX 2020 (co-authored with Laura Giordano and Matteo Baldoni).

Then, we translate the formalization in PROLOG into PROLEG.

During the activities of formalizing “choice of law” in PROLEG, it turns out that we can implement other important issue in private international law, that is “choice of jurisdiction” . Firstly, we modify ordinary PROLEG into a framework which handles

modules expressing each country's law, called "Modular PROLEG". We show the algorithm of deciding "choice of jurisdiction" for Modular PROLEG in Fig.1. This algorithm uses a framework of "general rules and exceptions" in PROLEG and therefore, it is the same reasoning mechanism as usual legal reasoning such as Civil Code reasoning.

```

prove( $S$ ) goal set  $S$ 
begin
  if  $S == \emptyset$  then return( $\emptyset$ );
  forall an atom  $A\#C \in S$  do
    if  $A\#C$  is a fact s.t. fact( $F\#C$ ) is in the factbase
      s.t.  $F\#C$  is unifiable with  $A\#C$  by most general unifier  $\theta$  then
        begin
           $S := (S - \{A\#C\})\theta$ ; return(prove( $S$ ))
        end
      else %  $A\#C$  should be a head in some rules
        begin
          select a rule  $(H \leftarrow B_1, \dots, B_n)\#C$  in the rulebase
            whose head matches  $A\#C$  with  $H\#C$  by most general unifier  $\theta$ ;
          if such a rule does not exist then return(false);
           $S := (S - \{A\#C\} \cup \{B_1\#C, \dots, B_n\#C\})\theta$ ;
          if prove( $S$ )= $S\delta$  then
            begin
              for every exception  $(G,E)\#c$  s.t.  $(A\#C)\theta\delta$  is unified with  $G\#c$ 
                by most general unifier  $\eta$ 
                if prove( $\{(E\#c)\theta\delta\eta\}$ ) then return(false)
              return( $S\theta\delta$ )
            end
          else if prove( $S$ )= $\text{false}$  then return(false)
        end
      end
    end
  end
end

```

Fig. 1. Algorithm of Meta-Interpreter for Modular-PROLEG

Then, we extend this Modular-PROLEG which can manipulate "choice of law". The below is an overview of reasoning about international affairs including choice of law.

1. We decide the country X whose law is applied to decide the matter P as follows.
 - (a) There should be a rule in the private international law in \mathcal{C} which indicates an applicable law in (possibly another) country \mathcal{C}' for the matter P in the country, \mathcal{C} .
 - (b) If $\mathcal{C}' = \mathcal{C}$, $X = \mathcal{C}$.
 - (c) Else ($\mathcal{C}' \neq \mathcal{C}$), we need to again decide the country X of the applicable law for P according to the private international law in \mathcal{C}' (called "envoi" here)
 - (d) If we detect a loop in the "envoi" (called "renvoi" here), we set the applicable law to the starting country of the loop. For example, if the private international laws makes this reference of applicable law, " $A \rightarrow B \rightarrow C \rightarrow D \rightarrow B$ ", then we decide an applicable law for the matter as country B.

2. We decompose the matter P into submatters according to a rule defined in the applicable law in X .
 3. If a submatter is determined by a global fact and the global fact is in the fact base, the submatter is valid.
 4. Otherwise, we iterate the process above (we decide an applicable law of the submatter and then check the submatter is valid in the applicable law). Every time we decompose an international affair into sub international affairs, we reason about choice of law which applies to each sub international affairs.
- We show the detailed algorithm of how to reason international affairs in Fig. 2 and 3.

```

pilprove( $S$ ) goal set  $S$ 
begin
  if  $S == \emptyset$  then return( $\emptyset$ );
  forall an atom  $A\#C \in S$  do
    if  $A\#C$  is a fact s.t. fact( $F\#C$ ) is in the factbase
      s.t.  $F\#C$  is unifiable with  $A\#C$  by most general unifier  $\theta$  then
        begin
           $S := (S - \{A\#C\})\theta$ ; return(pilprove( $S$ ))
        end
      else %  $A\#C$  should be a head in some rules
        begin
           $AC := \text{choice\_of\_law}(A\#C, \{\})$  % AC: Chosen law for  $A$  in  $C$ 
          select a rule  $(H \leftarrow B_1, \dots, B_n)\#AC$  in the rulebase
            whose head matches  $A\#AC$  with  $H\#AC$  by most general unifier  $\theta$ ;
          if such a rule does not exist then return(false);
           $S := (S - \{A\#C\} \cup \{B_1\#AC, \dots, B_n\#AC\})\theta$ ;
          if pilprove( $S$ )= $S\delta$  then
            begin
              for every exception( $G, E$ ) $\#c$  s.t.  $(A\#C)\theta\delta$  is unified with  $G\#c$ 
                by most general unifier  $\eta$ 
                  if pilprove( $\{(E\#c)\theta\delta\eta\}$ ) then return(false)
            end
            return( $S\theta\delta$ )
          end
        else if pilprove( $S$ )= $\text{false}$  then return(false)
        end
      end
end
end

```

Fig. 2. Algorithm of Modular-PROLEG Meta-Interpreter for PIL

```

choice_of_law( $A\#C$ , ReferringHistory)  $A\#C$ : a goal
begin
  if  $C \in \text{ReferringHistory}$  return( $C$ ); %Renvoi
  else if  $A == \text{envoi}(-, -)$  then return( $C$ ) % envoi's chosen law is always  $C$ 's law.
  else
    begin
      { $\text{envoi}(A\#C, EC)\theta$ } := return(solve( $\text{pil}$ , { $\text{envoi}(A\#C, EC)$ }));
      return(choice_of_law(( $A\#EC$ ) $\theta$ ,  $EC\theta \cup \text{ReferringHistory}$ ))
    end
  end
end

```

Fig. 3. Algorithm of Choice of Law

Using the above formulation, we programmed some articles of GDPR (general data protection rules) and verified its behavior.

(4) Future Work

We would like to develop more advanced man-machine interface to visualize reasoning process, and we would also aim at investigating comparison with other approaches for representing reasoning in private international law, especially in dealing with exceptions and contextual reasoning in the literature.

Publications (English Only)

1. Baldoni, M., Giordano, L., Satoh, K., "Renvoi in Private International Law: A Formalization with Modal Contexts", *Frontiers in Artificial Intelligence and Applications*, Volume 322: Legal Knowledge and Information Systems, IOS press, pp. 157 - 162, DOI 10.3233/FAIA190318 (2019).
2. Kozuka, S., "The style and role of judgments by Japanese courts: how they are written and read", *Zeitschrift für Japanisches Recht (Journal of Japanese Law)*, Vol 25 No 49, pp. 47-75 (2020). <https://www.zjapanr.de/index.php/zjapanr/article/view/1442>
3. Satoh, K., Baldoni, M., Giordano, L., "Reasoning about Applicable Law in Private International Law in Logic Programming", *Legal Knowledge and Information Systems, Frontiers in Artificial Intelligence and Applications*, Vol. 334, pp. 281-285 (2020). <https://ebooks.iospress.nl/doi/10.3233/FAIA200884>
4. Satoh, K., Giordano, L., Baldoni, M. (2021), "Implementation of Choice of Jurisdiction and Law in Private International Law by PROLEG Meta-interpreter", In: Baroni, P., Benz Müller, C., Wáng, Y.N. (eds) *Proc. of 4th International Conference on Logic and Argumentation (CLAR 2021)*, *Lecture Notes in Computer Science*, vol 13040. Springer. https://doi.org/10.1007/978-3-030-89391-0_4
5. Nishitani, Y., "Japan", (National Report on the Hague Principles in International Commercial Contracts), in: Daniel Girsberger, Thomas Kadner Graziano and Jan Neels (managing editors), Béligh Elbalti, Lauro Gama, Brooke Marshall, José A Moreno Rodríguez, Yuko Nishitani and Geneviève Saumier (regional editors), *Choice of Law in International Commercial Contracts: Global Perspectives on the Hague Principles* (OUP),

pp. 537–555 (2021).

6. Nishitani, Y., “Perspectives and Challenges of Multi-tier Dispute Resolution in Japan”, in: Anselmo Reyes & Weixia Gu (ed.), *Multi-tier Approaches to the Resolution of International Disputes: A Global and Comparative Study* (CUP, 2022), pp. 142–160.
7. Nishitani, Y., “‘Business and Human Rights’ in Global and Asian Perspectives”, in: *30th Anniversary of the Japan Association of International Economic Law* (Routledge, forthcoming 2022).

Invited Lectures (English Only)

1. Nishitani, Y., “New Developments of PIL in Japan” in *New Developments in Private International Law in East Asia*, 32e Journée DIP, Institut suisse de droit comparé (4–7 May, 2021).
2. Nishitani, Y., “Regional Perspective: Asia”, in *Book Launch Event: Choice of Law in International Commercial Contracts* (OUP 2021), ed. by Daniel Girsberger, Thomas Kadner Graziano, and Jan L Neels (4 May, 2021).
3. Nishitani, Y., “Litigation in Asia – Choice of Court Agreements & Judgments Recognition –” in *University of Lausanne, LLM program* (17–18, June, 2021).
4. Nishitani, Y., “The 2005 & 2019 HCCH Conventions and Commercial Judgments Circulation in the Asia-Pacific”, in *Charting the New Frontiers of International Dispute Resolution in the Asia-Pacific* (29, July, 2021).
5. Satoh, K., “Implementation of Choice of Jurisdiction and Law in Private International Law by PROLEG Meta-interpreter” in *4th International Conference on Logic and Argumentation (CLAR 2021)* (20–22 October 2021)
6. Kozuka, S., “Comments on the Report on “The Impact of Blockchains for Human Rights, Democracy, and the Rule of Law” in *Seminar by the Council of Europe, Human rights and legal aspects of blockchain technology* (9 March 2022).